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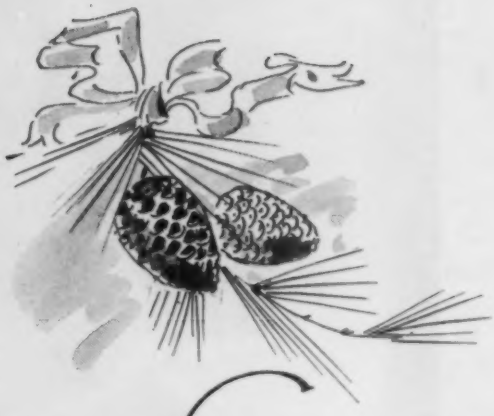

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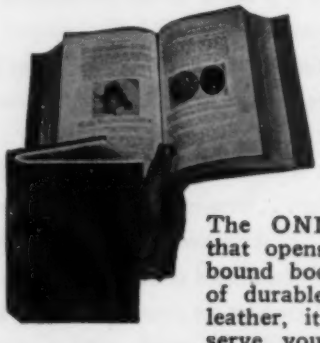

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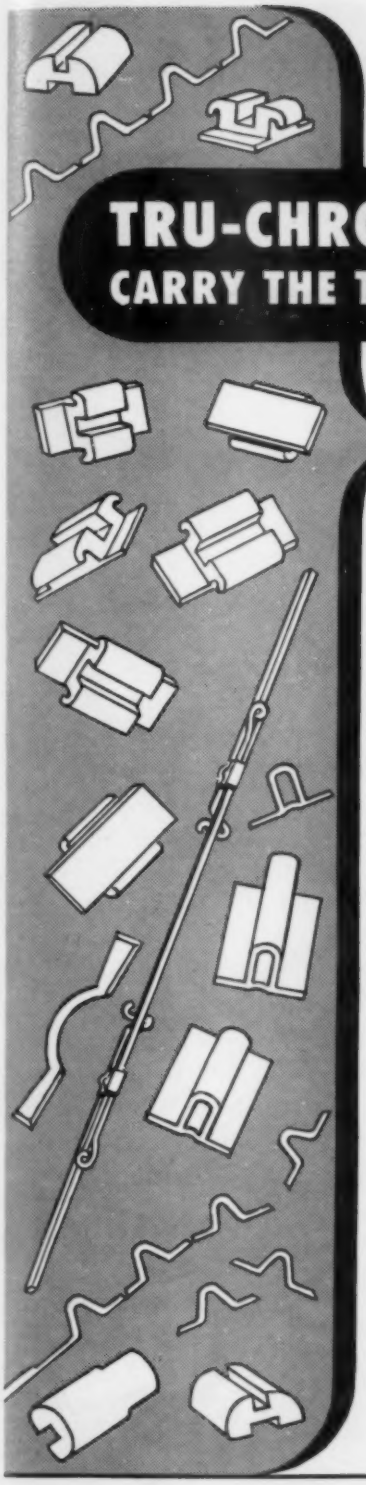

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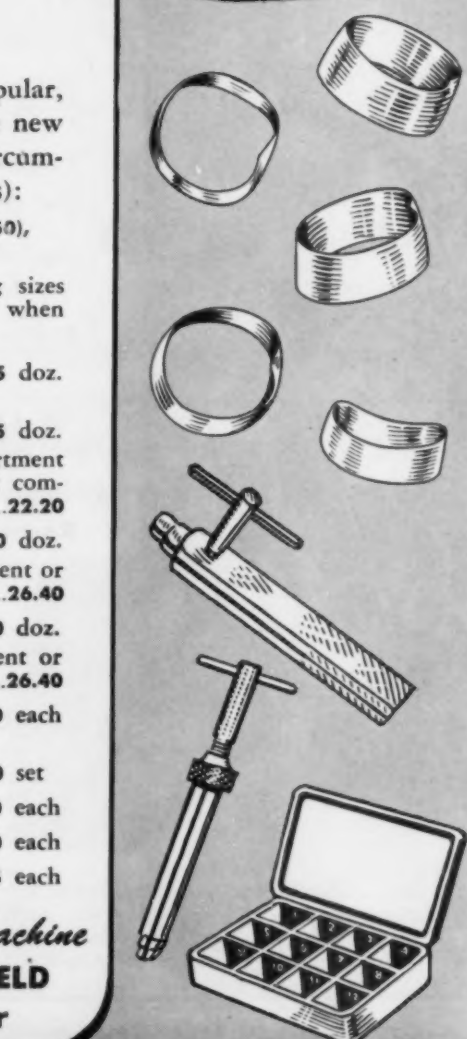

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Original Articles

VARIATIONS OF THE TEMPOROMANDIBULAR JOINT AS REVEALED BY CEPHALOMETRIC LAMINAGRAPHY

ROBERT MURRAY RICKETTS, D.D.S., CHICAGO, ILL.

INTRODUCTION

ANATOMY is not a completed science. There is still a need for studying anatomical parts in function. Even the range of normal morphologic variation of many structures has never been determined. Of equal interest are the processes predetermining body form and the phenomena which may affect it.

This study is concerned with the dynamic aspects of the human temporomandibular articulation and particularly with morphologic and functional variations. Investigations in this field have been hampered by the shortcomings of available research methods, and only the recent advances in the techniques of cephalometry and laminagraphy made the present study possible.

The purpose of the study was threefold. First, it was desired to test cephalometric laminagraphy as a method of investigation. Second, it was desired to study the range of normal variation in morphology and function and to attempt to correlate certain functions of the denture with the behavior of the temporomandibular joint. Third, it was desired to investigate possible differences between patients with Class II malocclusions and a control group of adequate size.

REVIEW OF PREVIOUS METHODS

Methods available for the study of the temporomandibular joint by means of the roentgen ray have been:

1. The exposure from the opposite side of the head and with the face resting on a cassette placed on a table or inclined surface (Gillis, 1935, Reisner, 1936). The presence of the petrous part of the temporal bone in the path of a true transverse ray made necessary the employment of various angular exposures which introduced distortion. Also, the reclining position of the head made the mandible the prey of gravity and this necessitated the clenching of the teeth.

This thesis was submitted as partial fulfillment of the requirements for the degree of Master of Science in Orthodontia in the Graduate College at the Chicago Professional Colleges of the University of Illinois, 1950.

This paper was given first honorable mention in the essay contest of the American Association of Orthodontists and was presented at the meeting in Chicago, May, 1950.

2. The Lindblom (1938) cassette holder and Higley's (1936) adaptation to the cephalometer. These permitted the taking of the x-ray with the head in an erect position. This made possible the taking of the rest position of the condyle but, since angulation was necessary, the distortion was still present. Also, the area covered by the exposure was not sufficient to include the condyle, fossa, and the buccal segment of the teeth.

3. Arthrography, as described by Norgaard (1947). The injection of a disclosing medium allowed detailed outline of the joint cavities but altered mobility of the condyle and concealed accurate outline of the bones.

4. Cephalometric roentgenology (Broadbent, 1931). This method, although yielding a complete image of the head, and one free of distortion, had the disadvantage of obscuring the joints because of the petrous element. Since the condyle comes down on the articular eminence during mouth opening, it was possible to obtain a complete and accurate silhouette of the mandible which could be used as a template for a study of jaw movements. The fossa, however, still remained obscured and its relation to the condyle could not be determined (Thompson and Brodie, 1942).

5. Body sectioning roentgenography or laminagraphy as described by Bleiker (1938), tomography, by Petrilli and Gurley (1939). This gave a clear picture of the fossa and condyle, but positioning of the patient made necessary the clenching of the teeth, and registered orientation necessary for serial studies was lacking.

The mechanical and optical principles involved in laminagraphy will not be dealt with here. The interested reader is directed to the works of Kieffer (1938) and Brader (1949). It is sufficient for our purpose to state that it involves the synchronous movement in opposite directions of the x-ray tube and the film cassette while the exposure is being made. At a calculated point between the two there is a center or level of no movement, and only structures lying in this plane are registered on the film. Everything above and below is blurred and decreased in density by movement and underexposure.

Kurz (1943) recognized the need for orientation and constructed a head holding device for successive laminagraphic exposures of the joint. Brader (1949) applied leaded scales to frontal laminagraph sections which permitted correction of dimensions to within 0.5 mm. The present study was made possible by the latter work and a redesigned head holder for the Kieffer x-ray laminagraph.

METHOD

The Head Holder and Its Application.—The head holder used in the present study was designed:

1. To make true lateral exposures of either the right or the left temporomandibular joint.

2. To make possible the taking of successive x-ray photographs susceptible to accurate mensuration so that quantitative as well as qualitative data could be gathered.

3. To expose a field large enough to inclule joint, teeth, and certain orienting planes of reference.

Because the laminagraph operates in a vertical position, the patient is required to lie prone with the head turned to the side (Fig. 1). The head holder is fitted to the bed-plate of the laminagraph and consists of one-half inch thick wooden platform, interchangeable vertical ear posts, and an orienting assembly. The initial positioning of the patient consists in placing one external auditory meatus on the ear post in the center of the platform. A stand with a retractable wooden arm holds a second ear post directly vertical to the first, and when this is placed in the upper ear canal the head is fixed in an axis that coincides with the central ray of the x-ray tube.

Fig. 1.—Patient in head holding apparatus. Note ear posts and assemblage supporting the nosepiece. Also note incisal plaster core registering rest position which had previously been taken with patient seated upright.

Since the ear posts orient the head only in one axis, additional attachments are needed to fix the head and register position. This takes the form of an adjustable assembly with a nosepiece which supports the lower side of the bridge of the nose. The assembly consists of a base which fits into a trough on the holder platform, and a pointer on the base indicates its position in the horizontal direction. The nosepiece or "nasion thumb" extends from an "orbital table," which is erected from the base, and is adjustable and calibrated vertically. The holder is symmetrical so that both joints can be taken by merely turning the head over.

In order to determine a cut that would fall through the center of the condyle, it was necessary to measure the patient's head. Preliminary to determining this depth of cut, a study was made on ten skulls and ten patients. It was found that the difference in biparietal and bicondylar width was approximately 3 cm. (Fig. 2). The soft tissue was of almost the same thickness for the cranium as for the lateral side of the condyles. It was further determined that the condyles measured from 1.5 cm. to 2 cm. in width. An accepted distance of 1 cm. from the lateral side of the condyle was taken to bisect each condyle.

If the difference in the biparietal and the bicondylar width was 3 cm., the distance for one side would be 1.5 cm. The added 1 cm., which was taken to

bisect the condyle, thus gave a measurement of 2.5 cm. from the widest part of the head to the center of the condyle. Since the holder platform was approximately 1 cm. in thickness, the distance from the table top to the center of the condyle would be 3.5 cm. (Fig. 2). As a rule, a cut at 3.5 cm. proved adequate. However, when extremes in obesity or head form were encountered, the cut was varied according to the measurements.

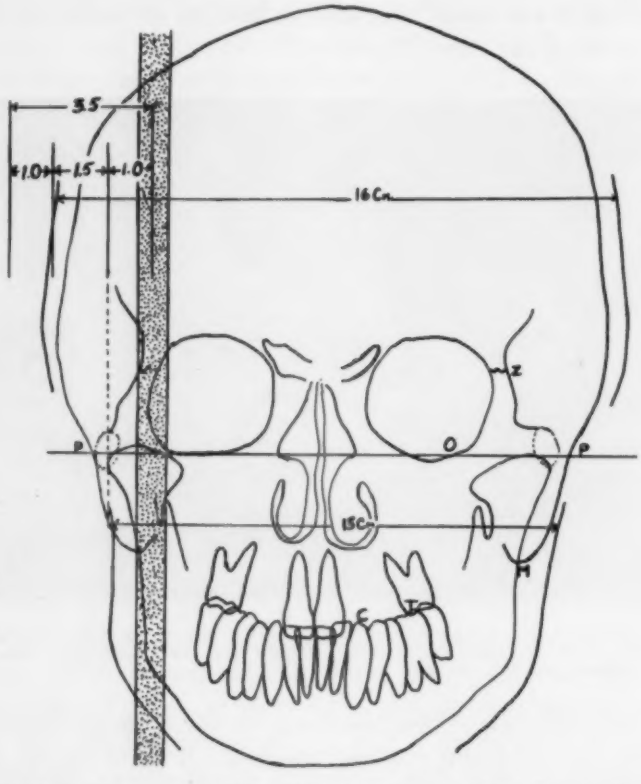


Fig. 2.—Frontal view of skull with stippled area showing the depth of cut and area projected on laminagraphic film. Note measurements of skull used in determining proper cut for individual patient.

Because the physiologic rest position was considered to be of great importance for this study, an extra precaution was necessary to eliminate errors arising from gravitational forces operating on the mandible as the patient lay in a prone position. This took the form of a plaster core of the teeth taken when the patient was sitting relaxed in an upright position. This procedure has been described by Thompson (1946) and consists of employing various means, such as licking the lips, pronouncing certain sounds, swallowing, to induce and maintain the rest position. White, soft, quick-setting plaster is introduced between the teeth by means of a plaster syringe. For this study, only the anterior teeth were included in the impression. The resulting core is replaced in the mouth prior to the exposure for the rest position x-ray photograph (Fig. 1).

Interpretation and Tracing of Films.—In laminagraphy it must constantly be borne in mind that all clearly visible structures lie in the same plane and only such clearly defined structures should be traced. In the sagittal plane through

the center of the condyle the entire ramus, including the coronoid process, the outer rim of the orbit, the zygomatic ridge, the ear canal, glenoid fossa, petrotympanic fissure, postglenoid process, articular eminence and mastoid air cells, and the zygomaticofrontal suture provide excellent checks on the accuracy of successive films and can be used as points of superpositioning. The sectional plane runs slightly to the lateral of the buccal teeth, but these structures are rendered with sufficient clarity to make them easily discernible.

Points, Planes, and Angles Selected for Study.—All x-ray films were traced on fine tracing paper (Traceofilm) and certain anatomical points inscribed. In addition, certain lines and planes were constructed for the purpose of making possible the analysis of movements and relationships. Linear measurements with correctional scales as described by Adams (1940) were made to the nearest 0.5 mm. Angular measurements were read to the nearest 1.0° with a standard protractor.

Fig. 3 represents a basic tracing of structures and points. These were located as follows:

P, Porion—the most superior point of the external auditory meatus.
O, Orbital—the most inferior point on the rim of the bony orbit.
Z, Zygomaticofrontal suture—the most anterior point (Frontomalare orbital).
C, Tip of the centrobuccal cusp of the mandibular first permanent molar.
T, Tip of the crown of the mandibular canine.
M, Tip of the mastoid process of the temporal bone.
PO, The Frankfort horizontal plane.
CT, A line passing through points *C* and *T* and representing the occlusal plane of the mandibular teeth.
RR', A line through the center of the long axis of the neck of the mandibular condyle (drawn on the first tracing of each series and transferred to subsequent tracings by superimposing the mandible).
HH', A line perpendicular to the Frankfort horizontal plane (*PO*) and passing through the summit of the eminentia articularis.

Fig. 4 indicates how the details noted were employed in the first step of the study, viz., the analysis of the closing movement of the mandible from its resting position to full occlusion.

The lines representing the Frankfort horizontal planes were superimposed and registered at the intersection of *HH'*. Additional identifying letters are to be seen on this figure, to wit:

D, The center of rotation or least movement of the lines *RR'*.
Fm, Interocclusal or posterior freeway space at the first permanent molar.
Fi, Interocclusal or anterior freeway space at the canine area.
B, Change of the occlusal plane from rest to closure (read in degrees).
C1, Angle formed by a line connecting the two *C* points with a perpendicular to *PO*.
C2, Angle formed by the same line with a perpendicular to the occlusal plane with the mandible at rest.

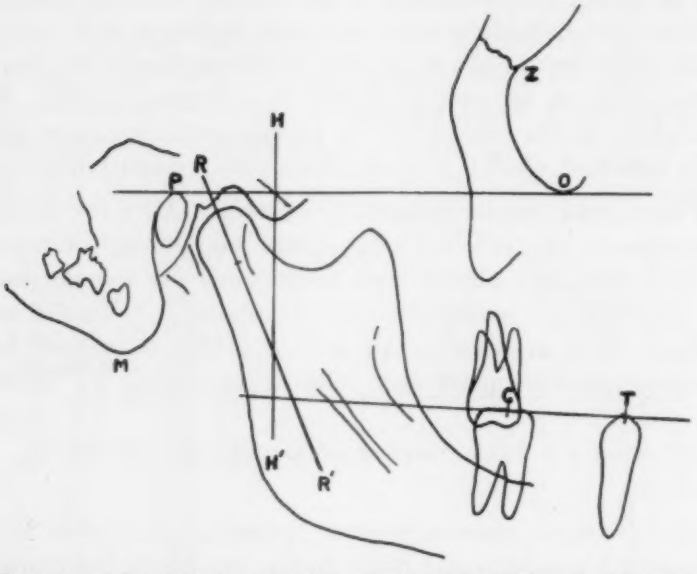


Fig. 3.—Tracing of laminagram showing points and planes of reference. *P*, porion; *O*, orbital; *Z*, zygomatic frontal suture; *M*, mastoid process; *C*, centrobuccal cusp of lower first molar; *T*, tip of lower canine; *PO*, Frankfort plane; *HH'*, perpendicular through *PO* at height of eminence; *CT*, occlusal plane; *RR'*, plane parallel to long axis of neck of condyle.

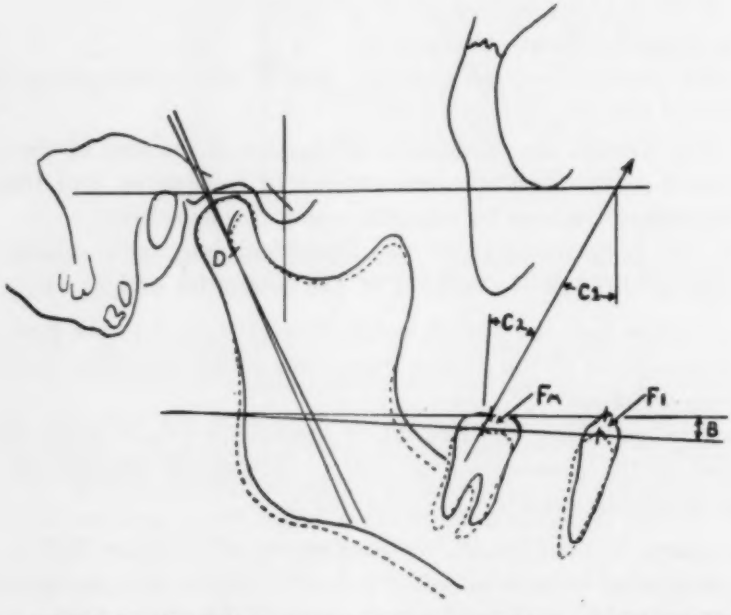


Fig. 4.—Illustration of method of analysis of movement of the mandible from rest position to closure. Dotted line indicates tracing at rest and solid line denotes occlusion. Point at *D* is center of rotation of condyle: *C1*, path of closure related to Frankfort; *C2*, path of closure related to occlusal plane at rest; *Fm*, *Fi*, interocclusal (freeway) space at molar and canine respectively; *B*, angle of divergence of occlusal plane at rest.

MATERIAL

The original sample taken for this study consisted of fifty individuals, and both the right and left temporomandibular joints were studied. The sample represented a reasonable cross section of the population and consisted of 31 individuals possessing normal occlusion or mild malocclusions, 13 Class I (Angle) malocclusions, 4 mild Class II (Angle) subdivision malocclusions, and 2 mild Class III (Angle) subdivision malocclusions. Laminagraphs were made of both the right and left joints with the jaws at rest and in full occlusion. Of these, 55 joints were taken with the mouth wide open in order to study the range and variation of this movement.

Midway through the study evidence pointed toward the possibility of a significant difference between the behavior of the sample and that of Class II malocclusion, and it was decided to include a study of the joint in that category. For this purpose a second group consisting of individuals exhibiting unquestionable Class II relation of the molar teeth was studied. Of this sample, 24 were of the Division 1 type (protruding incisors) and 19 were of the Division 2 type (retruding incisors). The remaining 7 cases could not be classified as to division. Both joints of each patient were laminagraphed at physiologic rest position and with the teeth in occlusion, and 48 joints were taken to study the range and variation of the wide open position.

The average age of the original group was 21.5 years and the grouping was as follows: six were from 4 to 10 years of age, ten were from 11 to 14, ten were from 15 to 22, and twenty-four were over 22 years old. One patient was over 40 years old.

The average age of the Class II cases was 14 years and here the range was as follows: ten were from 5 to 10 years of age, thirty were from 11 to 14 years, four were from 10 to 22 years, and six were over 22 years of age.

FINDINGS

A. Size of the Condyle.—A comparison of the relative size of the condyle to the glenoid fossa was made (Fig. 5,*D*) by dividing the entire sample into five categories, viz.: very small, small, average, large, and very large. Of the 200 joints, 3 condyles appeared to be very small in relation to the size of the fossa (Fig. 6,*A*) and 45 fell in the small group. Exactly one-half of the condyles were estimated to be of average size (Fig. 6,*B*); of the remaining cases, 45 were determined to be large and 7 were considered very large (Fig. 6,*C*).

When the groups were analyzed according to age there appeared to be a slight tendency toward large condyles in the adult ages. Six of the seven very large condyles were of adults and all of the very small condyles were those of children. In the large and small groups, 26 condyles of adults were large while only 12 of the small condyles were of the adult age.

B. Movement of the Mandibular Condyle.—

From Resting Position to Full Closure.—It should be noted in passing that there is general agreement that the condyle moves only very slightly from the rest position to full closure and that such movement is of a purely rotary type

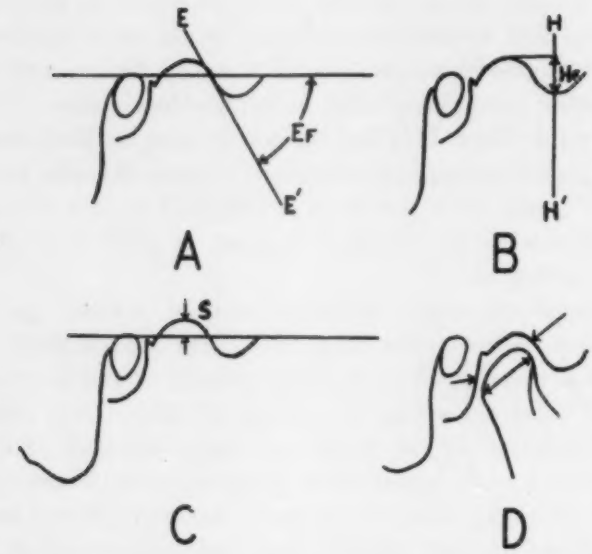


Fig. 5.—*A*, Method of measuring angle of the eminence *Ef*; *B*, method of measuring height of eminence *Hf*; *C*, method of measuring fossa relation to Frankfort plane at *S*; *D* represents criteria for appraisal of size of condyle in comparison to fossa.

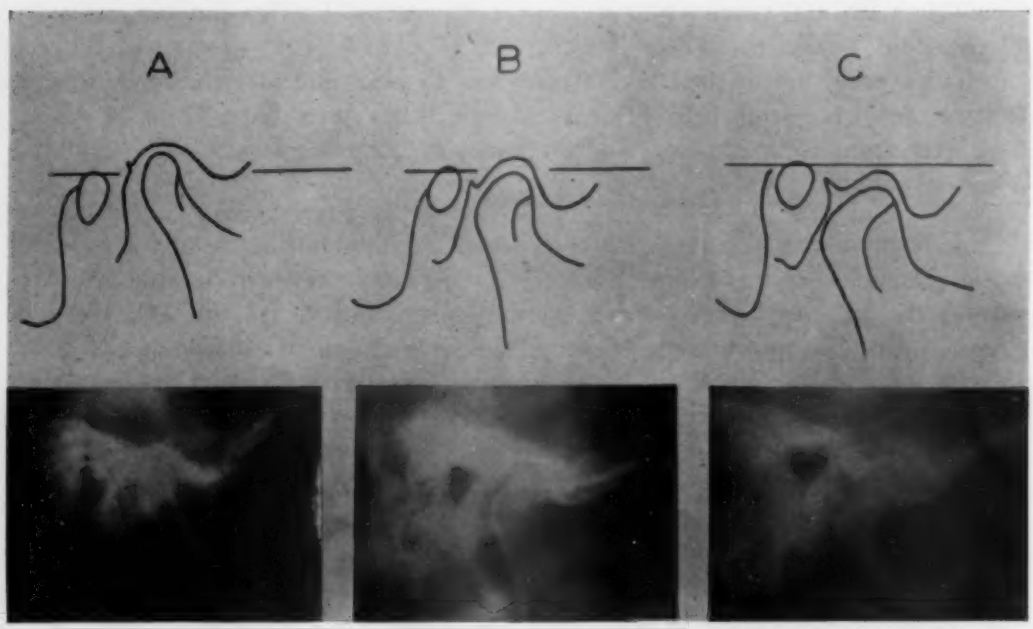


Fig. 6.—*A* illustrates tracing and laminagraph of very small condyle compared to the fossa. *B* represents an average-sized condyle related to the fossa. *C*, Case of very large condyle in comparison to the fossa. Note the postglenoid tubercle almost superior to the condyle. Note also difference in position of fossa relative to Frankfort.

with its center just below the head of the condyle (Higley and Logan, 1941; Thompson, 1946, 1949).

The point *D* was found to be very stable in the control group. Fifty of the one hundred joints failed to move enough to permit measurement (Figs. 4 and 7,*A*). Thirty-six showed a movement of less than 1 mm. and fourteen, less than 2 mm. (Fig. 8). These slight movements were in different directions, the greatest number being in upward and posterior directions (Fig. 7,*B*).

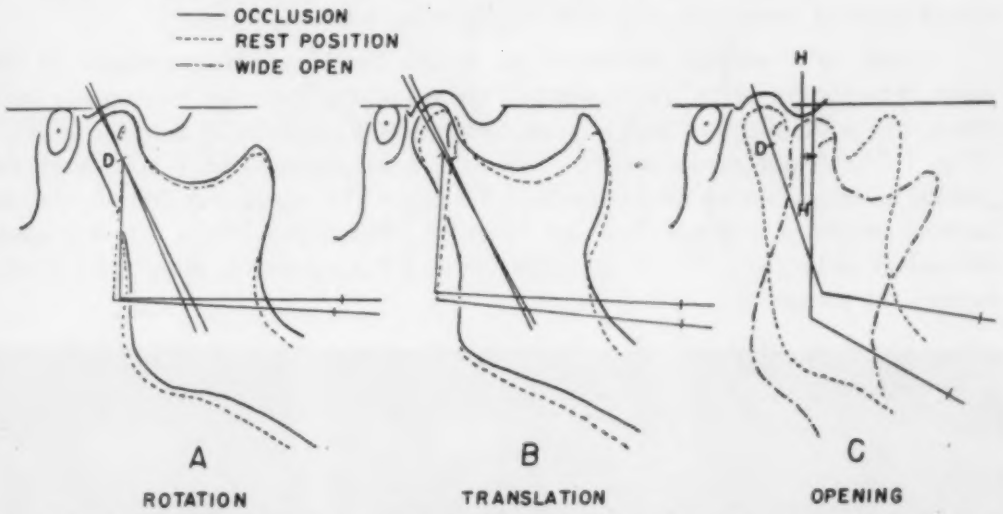
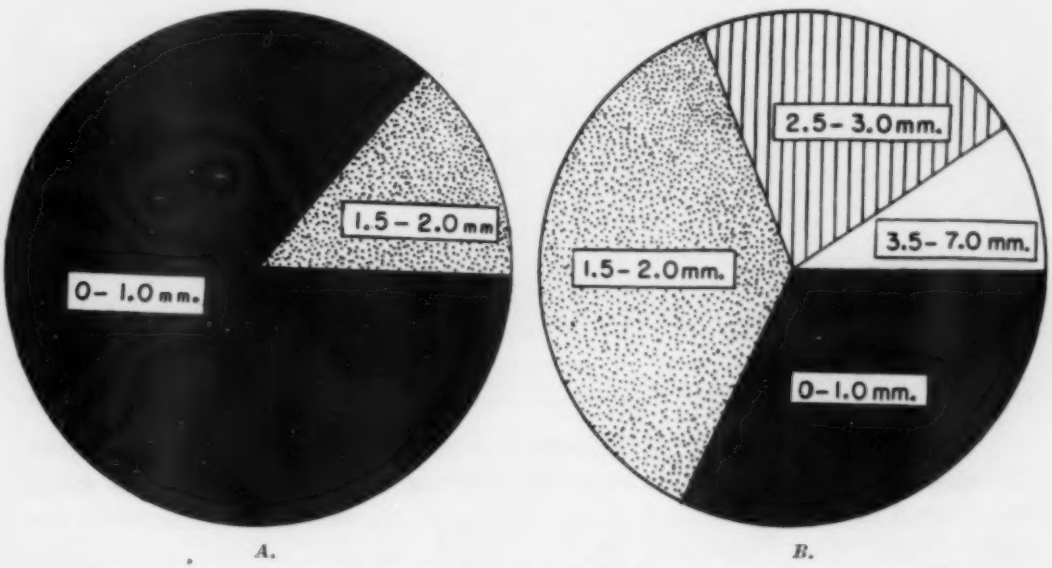


Fig. 7.—Method employed in analysis of movement of condyle. *A*, No movement of point *D*, with rotation of mandible from rest to closure. Note molar path upward and forward. *B*, Movement of point *D* with translation of condyle and mandible. Note molar path upward and backward. *C*, Movement of point *D* anterior to plane *HH'* in opening.



A. *B.*

Fig. 8.—Pie diagrams of movement of the condyle in the control and Class II groups. The black area corresponds to Fig. 7*A*. The stippled area represents behavior as seen in Fig. 7*B*. The lined and plain sections indicate cases in which the condyle was forward at rest position as illustrated in Fig. 15. *A*, Normal range of movement of condyle from rest to closure in 100 cases; *B*, range of movement of condyle from rest to closure in 100 cases with Class II malocclusion.

In the Class II group, the findings were quite different. Here the point was found to move over a significantly greater range. Thirty-two of the condyles moved up to 1 mm., thirty-seven moved up to 2 mm., twenty-two moved up to 3 mm., six moved 4 mm., two moved 4.5 mm., and one moved 7 mm. (Fig. 8).

With the greater range it was possible to measure the direction of movement more accurately. Of the 100 condyles in this group, 50 moved posteriorly from 2 mm. to 5 mm. In the superoinferior direction of those that moved, all moved upward, over half of them traveling from 2 mm. to 4 mm.

Extent of Condylar Movement in Mouth Opening.—Measurement of the point *D* to the line *HH'* (representing the tip of the articular eminence), with the mouth wide open, yielded a mean distance of 1.7 mm. of *D* anterior to *HH'* (Fig. 7,*C*). These measurements, however, when grouped at 1 mm. intervals yielded a skewed curve with a peak at 3.5 mm. The range was from 5 mm. in back of eminence to 8 mm. in front (Fig. 9). Thirty-one of the fifty-five cases showed *D* to be from 1 to 5 mm. anterior and five opened to more than 5 mm. beyond the eminence.

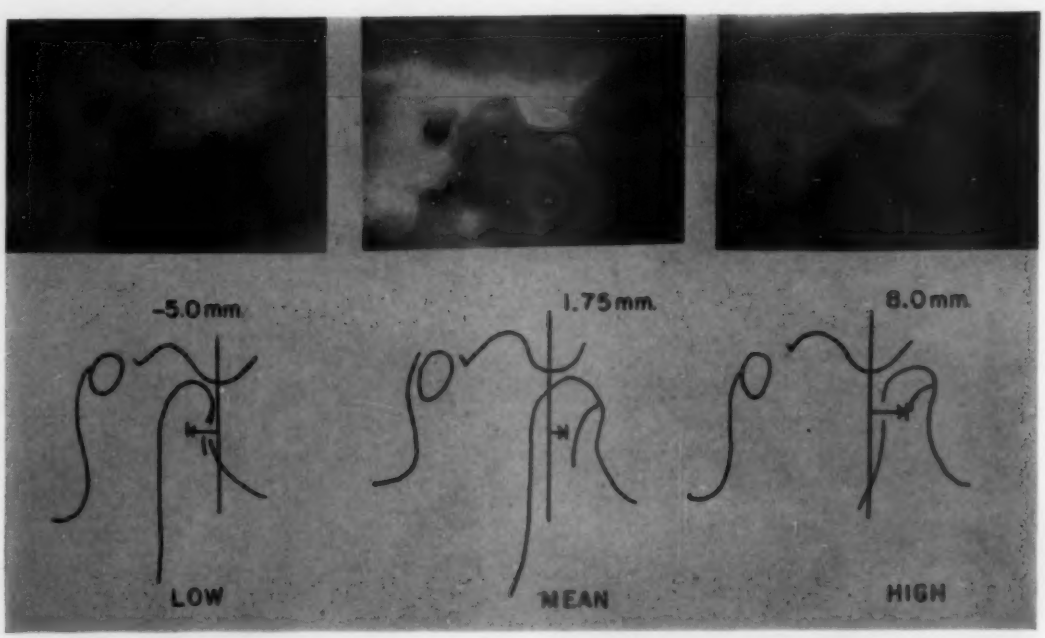


Fig. 9.—Illustration of range of variation found in position of condyle with mouth wide open. Note that "low" is hardly to the summit of the eminence, the "mean" is slightly forward to the eminence, and the "high" is completely anterior to the entire articular tubercle.

In the Class II group, the findings were similar but the range was greater. The mean for these forty-eight cases was 2.6 mm. anterior to *HH'*. The range was from 6 mm. posterior to 8.5 mm. anterior to the eminence. The curve was again skewed with its peak at 4 mm.

RELATIONS OF THE CONDYLE

Anteroposterior Relation of Mandibular Condyle to Eminentia Articularis.—The method employed to measure this relationship is indicated in Fig. 10 where

Gr indicates the point on the eminence that is closest to the condyle when the mandible is at rest. The same points are transferred to the subsequent picture and the distance between them measured to determine the change, if any, that occurs when the teeth are occluded (*Go*).

As was to be expected from the study of the movement of the point *D* during closure, no essential difference was found. The mean distance at rest was 1.49 mm. and in occlusion, 1.51 mm. Although the range was 0.5 mm. to 3.0 mm., the standard deviation was 0.5 mm. (Fig. 11).

Fig. 10.—Method employed in measuring position of the condyle in relation to the eminence, the fossa, and the external auditory meatus. *Gr*, Distance from condyle to eminence at rest; *Go*, same measurement in occlusion; *Kr*, distance from condyle to top of fossa at rest; *Ko*, same measurement in occlusion; *Nr*, measurement from line through center of EAM to posterior surface of condyle at rest; *No*, same measurement in occlusion.

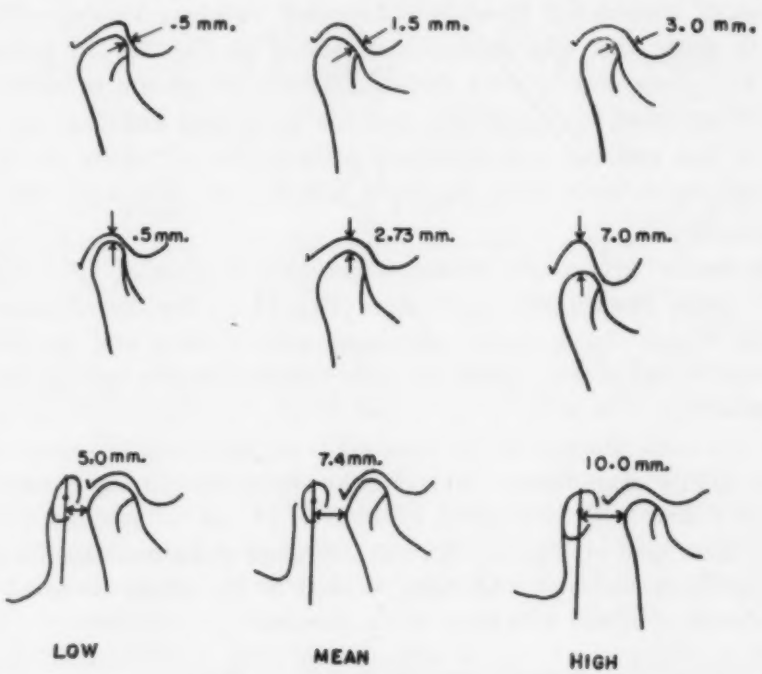


Fig. 11.—Positions of condyle at rest in the normal group. Top figures represent range of variation in Gr measurements. Middle figures represent range of Kr measurement. Lower figures represent range of Nr measurement.

In the Class II group the means were 1.51 mm. for the rest position and 1.61 mm. with the teeth in occlusion. The difference between the two groups in the matter of this relationship was not thought to be significant.

Superoinferior Relation of Mandibular Condyle to Glenoid Fossa.—For the study of this relationship lines parallel to each other and to *PO* were drawn tangent to the most superior point on the condyle and to the roof of the fossa (*Kr* and *Ko* in Fig. 10).

The mean measurement of this distance in the control group with mandible at rest was found to be 2.73 mm. with a standard deviation of 1.05 mm. The range of the sample was quite wide (0.5 mm. to 7.0 mm.), but only 7 cases measured more than 4 mm. (Fig. 11). The same measurement, when taken with teeth in occlusion, yielded a mean of 2.44 ± .85 mm. and, as might be expected, the range was narrower (1 mm. to 5.5 mm.).

When the Class II group was subjected to the same measurements, certain significant differences were noted. At rest, the mean of this group was 3.78 mm. ± 1.07 mm. The range, however, was from 1.5 mm. to 6.5 mm. with 33 lying in the 1.5 mm. to 3 mm. group, 62 in the 3.5 mm. to 5 mm. group, and 5 that exceeded 5 mm. The range of these last two groups exceeded that of almost the entire control group.

When the teeth were in occlusion, the difference between the two samples tended to disappear. Indeed, the values were almost identical. The mean distance of the Class II sample was found to be 2.48 mm. ± 0.77.

Relation of Mandibular Condyle to External Auditory Meatus.—The method employed to study this relationship is indicated in Fig. 10. A perpendicular from the PO plane was erected through the center of the external auditory meatus as determined by inspection, and the horizontal distance was measured between this line and the most posterior point of the curvature of the condyle. Measurements were made with the lower jaw at rest (*Nr*) and with the teeth in occlusion (*No*).

In the control group, this measurement gave a mean of 7.4 ± 1.16 mm. at rest with a range from 5 mm. to 10 mm. (Fig. 11). The distribution was that of a normal curve. In occlusion, the mean was 7.2 mm. and the distribution similar to that found at rest. This was to be expected on the basis of the behavior of the D point.

When the same measurements were made on the Class II group, the differences were highly significant. At rest, the mean measurement was found to be 8.54 mm. ± 1.86, with a range of 4.5 mm. to 14 mm. Thus, not only was the mean larger than that of the controls, but the range was almost one-third greater. With the teeth in occlusion the mean as well as the range dropped to values that were almost identical with those of the controls.

MORPHOLOGIC VARIATION OF FOSSA

Angle of the Articular Eminence.—This is a measure of what is commonly called in dental terminology the "Condyle Path." The method employed to measure it for the purposes of the present study is illustrated in Fig. 5,*A*. It consisted of constructing a tangent (*EE'*) to the longest curvature of the pos-

terior slope of the eminence and measuring the angle (*Ef*) formed by such a line with the PO line. The angular relation of the same line to the occlusal plane was also measured.

In both the control and the Class II groups the mean was found to be 54°. Range of variation for the controls was from 25° to 77° (Fig. 12) and for the Class II group was from 38° to 83°. The standard deviation of both groups was of the value of 10°, but the frequency curves displayed some skewness toward values higher than the means.

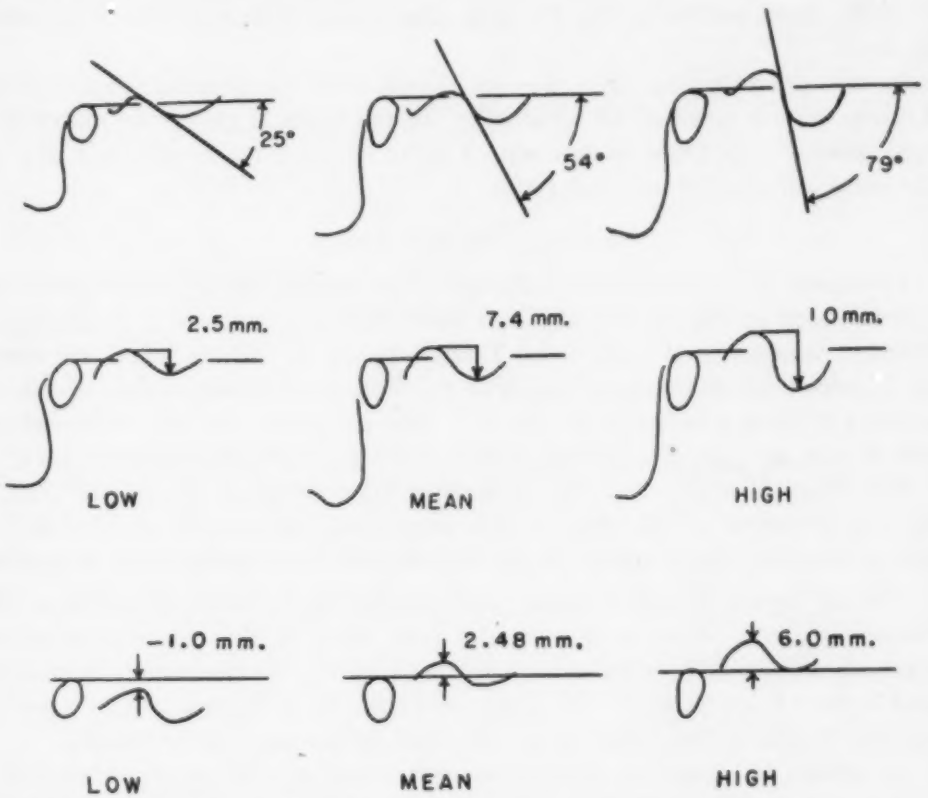


Fig. 12.—Range of variation in (1) angle of the eminence (top figures), (2) height of eminence (middle figures), and (3) relation of top of fossa to Frankfort plane (bottom figures).

When the slope of the eminence was related to the occlusal plane the means were again almost identical, i.e., 44° to 43°. The slight difference in the standard deviations indicated a slightly wider range in the control group. In neither of these measures could any relation be found between the type of occlusion and the slope of the eminence.

Height of Eminentia Articularis.—This measure was made in the manner indicated in Fig. 5,*B*. A tangent to the floor of the glenoid fossa and parallel to the PO line was drawn to intersect a perpendicular to PO and passing through the height of the eminence.

This measurement showed no significant difference to exist between the two groups studied. In the control group the mean was 6.3 ± 1.3 mm., and in the

Class II group the mean was 6.2 mm. The ranges were likewise similar, that of the control being from 4.0 mm. to 11.5 mm. and the Class II being 4.5 mm. to 9 mm. (Fig. 12).

Relation of Roof of Glenoid Fossa to PO Line.—This measurement was taken to test the validity of the claim that the relation between the fossa and the external auditory meatus is a very constant one. It was studied by measuring the distance between the PO plane and the most superior point in the fossa. A value of 0 was given where the two coincided, minus values indicated that the roof of the fossa was below the PO line, plus values indicated that it was above (Fig. 5,*C*).

In the control group there was an almost even distribution from –1.0 mm. to 6.0 mm. with a mean at 2.5 (Fig. 12). In the Class II group the distribution ranged quite evenly from –3 mm. with a mean of 1.4 mm. Seventy-six per cent of the cases fell in the 0 to 3 mm. range.

RELATIONS OF THE TEETH

Variation of Cant of Occlusal Plane.—The method used in determining this relation is seen in Fig. 3. Parallel *PO* and *CT* planes indicate 0° value as plus values are demonstrated when point *T* drops below *C*. Minus values are seen in cases in which the canine is superior to the molar. The mean value of the control was 7.5° with a range of –6° to 16°. The range of 2° to 13° embraced two-thirds of the sample. The curve skewed slightly toward the higher values.

The Class II group showed a slightly longer range at –9° to +19° but the mean was 2° lower. Two-thirds of this sample fell between 0° and 11° and the distribution curve was normal. Thus, the differences are questionably significant.

Size of Space Between Upper and Lower Teeth With Mandible at Rest (Freeway Space).—Two measurements were made of this space, one between molar points and one between canine points (Fig. 4). At the molar the mean was found to be 1.8 ± 0.89 mm. The range was 0.5 mm. to 4.5 mm., but 80 per cent measured 2 mm. or less, and 3 mm. embraced 94 per cent of the sample.

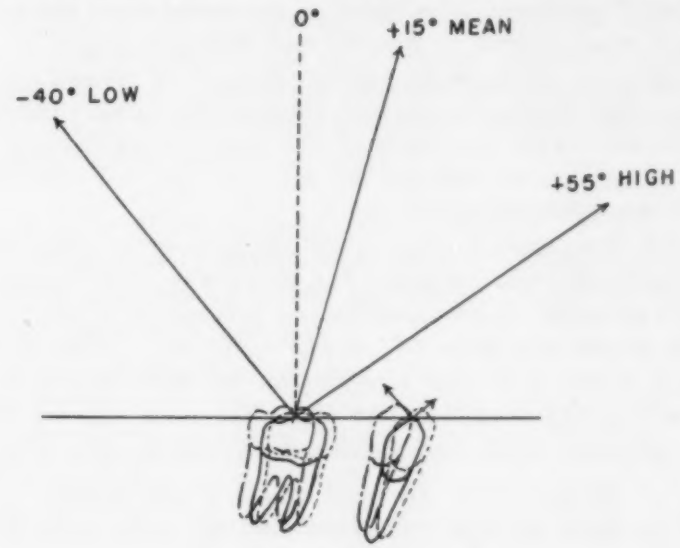
As would be expected, the values at the canine (T) were higher but the range was similarly small. The mean was 2.75 ± 1.15 mm. Eighty per cent measured 3 mm. or less, and 93 per cent, less than 4 mm.

When the same measurements were made on the Class II sample, significant differences were found. The mean value of the measurement taken at the molar was 3.56 ± 1.54 mm. The range was nearly twice that of the control (0.5 mm. to 7.5 mm.), but only 28 per cent measured less than 2 mm. and 52 per cent measured 3 mm. or less. All of the rest exceeded 3 mm. with 15 cases at 4 mm., 16 at 5 mm., 12 at 6 mm. and 5 up to 7.5 mm. Parallel findings were made at the canine points. The mean was 4.73 mm. ± 2.07 and a range from 0.5 mm. to 10 mm.

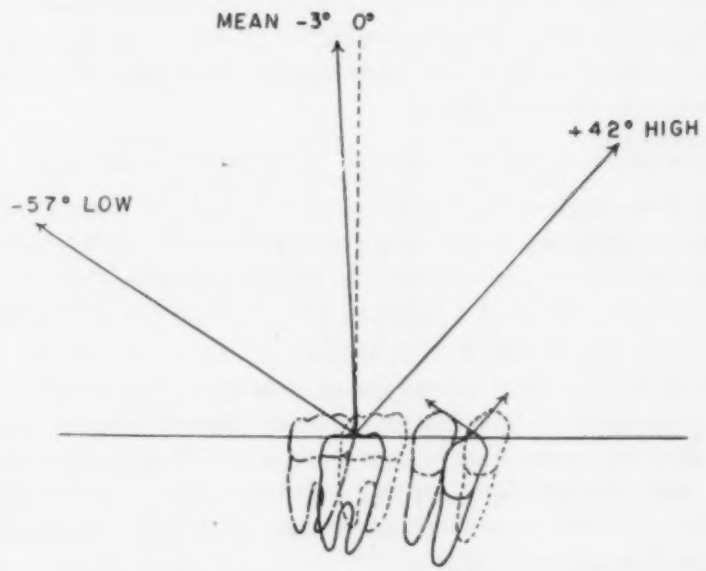
MOVEMENT OF THE TEETH

Direction of Path of Closure.—To study the direction in which the mandible moved from rest to closure, i.e., upward and forward, straight upward, or upward and backward, the *C* points on the molar at its two positions were con-

nected and the line projected upward (Fig. 4). (The analysis from Frankfort plane was discontinued when it was found that the occlusal plane tended to be a more reliable plane from which to take the measurement.) A perpendicular was erected to the *CT* line at point *C* on rest position tracing and the angle formed



DIRECTION OF PATH OF CLOSURE FROM OCCLUSAL PLANE



PATH OF CLOSURE FROM OCCLUSAL PLANE OF CLASS II

Fig. 13.—Range of variation in direction of movement of the lower first molar from rest position to occlusion, analyzed from the occlusal plane. Top, control; bottom, Class II.

by this perpendicular and the *C* line projection (path of closure) was read. When the projection and the perpendicular coincided, a value of 0° was given; when the projection fell forward of the perpendicular it was noted as a plus, and when it fell posteriorly it was noted as a minus. Thus zero values indicated straight upward movement, plus values, a movement in an upward and forward direction, and minus values, an upward and backward direction.

The mean value of the control group was +15° (forward and upward) and there was an even distribution on both sides of this value. The total range was from –40° to +55° with two-thirds of the cases falling between –6° and +34° (Fig. 13). Ninety-one of the cases fell between –10° and +50° but there were 7 that yielded values below –25°.

When the same measurements were taken from the Class II sample, very significant differences were noted. The mean was –3.15° (backward and upward) with two-thirds of the cases falling between –27° and +20°. The total range of this sample was from –57° to +42° (Fig. 13). When the readings were laid out on a curve with class intervals of 15° there was a tendency toward bimodality with peaks at –22° and at +22°. There was a fairly high plateau between them, however, which made significance questionable.

Nature of Movement of Occlusal Plane From Resting Position to Occlusion.—It is quite generally accepted that the movement of the mandible from rest position to occlusion is purely rotary in an upward and forward direction. To check this the angle *B* (Fig. 4) was constructed to projecting the *CT* lines backward in the two positions until they intersected each other. A closure of the angle indicated rotation. The control sample yielded a mean of 1.6° with ninety rotating from 1° to 3°. Five cases rotated from 3° to 4.5° and five showed no rotation, i.e., the movement was of a translatory nature.

In the Class II sample the mean was 2.75° ± 1.6°, and nine cases showed translatory movement. Thirty-two cases rotated more than 3°. These differences were thought to be significant.

COMPARISON OF CERTAIN ASPECTS OF DIVISIONS OF CLASS II

Movement of Condyle.—Movement of the condyle in those Class II cases which could not be assigned to one or the other divisions tended to behave in a manner similar to that of the normal. Division 1 showed more movement of point D with a mean of 2.1 and a range of 0 to 7 mm. than the Division 2 cases with a mean of 1.8 and a range of 0 to 4 mm.

Interocclusal Space.—The interocclusal (freeway) space was slightly different in the three groups. The first group again showed tendencies toward the control. The Division 1 was narrower at a mean of 3.3 mm. and a range of 0.5 mm. to 7 mm. than the Division 2, with a mean of 4 mm. and a range of 2 mm. to 7.5 mm. The vertical space taken at canine (anterior freeway) showed the same tendencies although naturally larger.

Rotation of the Occlusal Plane.—The rotation of the occlusal plane became progressively wider as the space became larger. The mean of the unclassified Class II was 2° with a range from 0° to 5°; the Division 1 was 2.5° with a range from 0° to 6°; the Division 2 was 3° with a range from 0° to 7°.

Path of Closure.—Contrary to common belief, the path of closure of Division 1 cases was found to be more distal than the Division 2 cases. The mean direction of the Division 1 from the occlusal plane was –8° with a range of +37° to –57°. The Division 2 cases showed a mean of +1.4° and a range of +37° to –40°.

Although not measured, the position of the mandible at rest seems to be correlated with the degree of overbite and overjet. As the Division 1 case has both overbite and overjet, the position of the mandible tends to be downward and forward at rest. As the Division 2 case has deeper overbite, the resting position is wider and not as far forward as the Division 1.

CROSS-SECTIONAL AGE CHANGES

In order to make a more critical analysis of age changes, the control and the Class II groups were combined. The age groups, divided for obvious reasons of changes in dentition, were as follows:

32 joints in the age range 5 to 10 years
80 joints in the age range 11 to 14 years
28 joints in the age range 15 to 22 years
60 joints in the age range over 22 years

As shown in Fig. 14, the mean angular measurement of the eminence from PO plane measured 46.7°, 52.8°, 57°, and 58.6°. The mean height of the eminence increased as follows: 5.5, 5.9, 6.8, and 7 mm., and the mean distance from the top of the fossa to PO increased 1.4, 1.9, 2.0, and 2.4 mm.

SUMMARY OF FINDINGS

1. There was found to be considerable variation in the relation between size of fossa and size of condyle. Some condyles appeared quite small for the fossae with which they were associated and others appeared too large for the cavity.

2. In Class I (Angle) occlusions the point of least movement from rest position to occlusion was found to be situated in the neck of the condyloid process. This was called the D point in this study and it revealed very slight movement in any direction. In Class II malocclusions, however, the point did move, predominantly in an upward and backward direction.

3. The condyle in both Class I and Class II cases tended to move forward of the tip of the eminentia articularis during wide opening movements. The main difference between the two classes lay in the range, that of the Class II being slightly larger.

4. The relation of the condyle to the slope of the articular eminence was quite constant. It showed less variation than any of the other measurements and this was true in both Class I and Class II.

5. The relation of the top of the condyle to the roof of the fossa exhibited considerable range, particularly at the rest position. In the Class II group there was a strong tendency for the condyle to lie low in the fossa at this position. The values, when taken with the teeth in occlusion, were almost identical for the two samples.

6. The relation of the condyle was found to vary more than has been thought in its relation to the external auditory meatus (5 to 10 mm.) with the condyle at physiologic rest, but some of this variation is explainable on the basis of the absolute size of the condyle. In Class II the distance between these two structures at rest was significantly greater because the condyle tended to be forward at this position.

7. The slope of the posterior surface of the articular tubercle was found to exhibit a wide range of variation (50°) in both Class I and Class II, and no definite difference could be established between the groups.

8. There did not seem to be any relation between steepness of the condylar path and the type of occlusion when related to the occlusal plane.

9. Aside from a high degree of variation nothing significant was noted about the height of the eminentia articularis and no differences were noted between the two samples studied.

10. The roof of the glenoid fossa was found to vary from a position slightly below the level of the PO line to one 6 mm. above it. That of the Class II group was at a slightly lower level, but it should be pointed out that this could be explainable on the basis of age, the Class II sample being younger.

11. Division 1 showed a more posterior path of closure than the Division 2, but Division 2 showed wider interocclusal (freeway) space.

12. The mean values of the angle to the eminence increased with age as the height of the eminence increased.

DISCUSSION

Probably the most arresting concept gained from this study is the great range of variation found in practically every aspect investigated. The findings emphasize, to the writer at least, the danger of accepting conclusions based on average values or from methods that do not accurately reveal conditions in the living. Isolated cases could lead the investigator to believe many dogmatic statements concerning the subject, but when a large sample is studied there is scarcely a single generalization that holds.

The almost total lack of correlation found between size of condyle and size of fossa does not support the idea that form and function, as generally considered, go hand in hand (Tomes and Dolomore, 1901; Harris, 1938; Breitner, 1941; Moses, 1946). All evidence pointed to a relatively high degree of independence between the two. This finding supports Todd's (1930) contention that "form does not slavishly follow function," and corroborates Angel (1948) concerning morphologic development, where he stated that "genes appear more important determinants than environment." Similarly, no correlation could be discovered between the type of occlusion and the slope of the posterior surface of the eminentia articularis which has frequently been claimed to exist (Reisner, 1936). The two elements of the joint, i.e., the condyle and eminence, in the samples studied showed no tendency to adapt themselves to each other, or to the occlusion.

It was thought that there might be some correlation between age and steepness of the slope of the eminence, and when samples were divided into four age

groups and the means compared (Fig. 14), there was some indication that steepness did increase with age. However, a scatter diagram failed to bear this out. In a similar way, the height of the eminence failed to indicate any striking age correlation. The major part of its growth apparently has occurred by the time the first permanent molars are erupted, and there tends to be a steady but slow increase in height until adulthood. However, the great typal differences encountered make any generalization hazardous. The increase in the measurement from the fossa to Frankfort plane also indicated age changes, but longitudinal studies would be necessary to clarify all of these points.

Some support was found for the contention that the position of the fossa can be determined from the location of the posterior surface of the condyle (Wylie, 1947), although this was true only when the teeth were in occlusion. Under this condition, the variation in mandibular position was reduced to a minimum but, of course, the lack of correlation in size of condyle and fossa still remained.

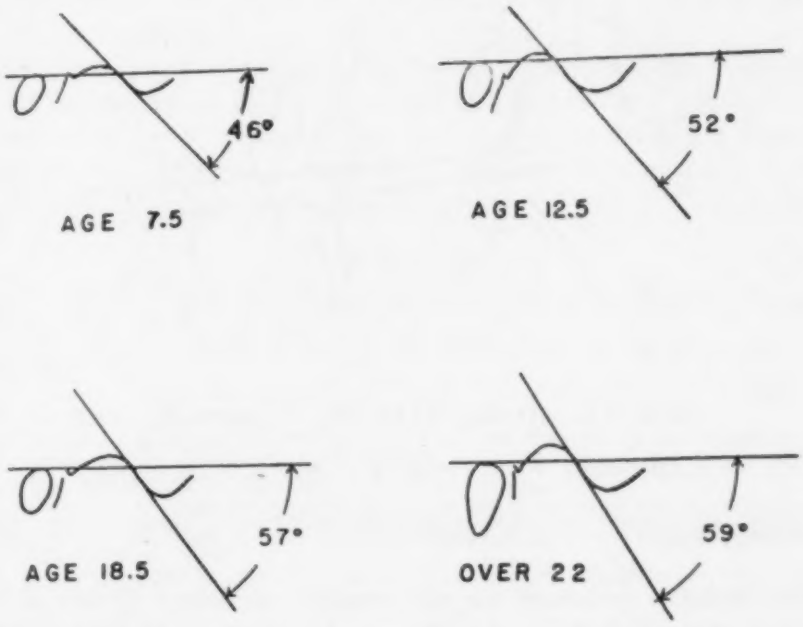


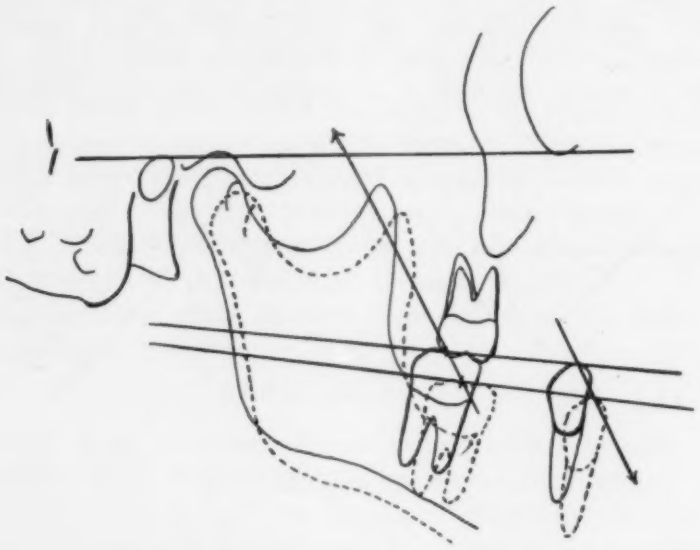
Fig. 14.—Mean growth changes. Note increase in angulation of eminence, increase in height and increase in distance from the top of the fossa to Frankfort plane.

No evidence was found to support the idea that the postglenoid process plays a role in preventing posterior displacement of the condyle (Sicher, 1948). It was always present, and there were many cases in which it possibly could act in this manner, but other cases showed it to be relatively undeveloped, and too far above a low-positioned condyle to have any effect.

It is not only possible for the condyle to travel forward of the tip of the eminence in wide mouth opening, but this appears to be normal behavior in the majority of cases.

The positional relation of the condyle to the fossa with the teeth occluded exhibited in both samples very small differences from that generally accepted on the basis of previous x-ray investigations (Reisner, 1936). Point *D* was quite uniform in both the resting and occluded positions in the control group (Figs. 7,*A* and 8).

In the Class II cases, at resting position, however, the relation of the condyle to the fossa ranged from its typical position high in that cavity to one near the tip of the eminence. The condyle in these cases exhibited a significant range of movement in an upward and backward direction when the mandible traveled from rest to closure (Figs. 7,*B*, 8, and 15).



CASE EXHIBITING EXTREME DOWNWARD AND FORWARD POSITION AT PHYSIOLOGIC REST

Fig. 15.—Case representing characteristic phenomenon found in about one-third of Class II cases. Note wide space between the teeth and distal path of closure.

These findings confirmed the observations of Blume (1947) and Boman (1948) of movement of the condyle from rest to closure. They determined that the "normal" movement is predominantly one of rotation of the condyle while that of Class II exhibited a range of translatory movement. However, in those studies, quantitative measurements were not taken to determine the position of the condyle at the start or completion of this movement.

The means of the control group indicated that the path of closure was upward and forward at 15° from a perpendicular to the occlusal plane. It was noted, however, that cases classified as normal could move upward and backward, although only 8 of these cases exhibited this behavior to an extent of more than –10°. The Class II sample, on the other hand, showed a pronounced shift of the mean and of the entire range in a posterior direction. The author could find no

previous study on the direction of path of closure of the molar, nor on the degree of rotation of the occlusal plane from rest position. Here again the variation was large.

A finding that was just the opposite to that expected was the different characteristics in the divisions of Class II. Those which did not lend themselves to assignment to one or the other of the classical divisions were shown to resemble the control in behavior. It was expected that the Division 2 type, which yielded slightly higher values in interocclusal space, would tend to show more posterior movement from rest to closure. Just the opposite was true. The Class II, Division 2 cases revealed a mean path of closure from the occlusal plane of +1.4° with the Division 1 group yielding a mean of –8.0°. This might denote either a more forward resting position in Class II, Division 1, or a difference in the pattern of muscular control in the two groups.

It seems apparent that a complete and correct analysis of the temporomandibular joint, for either investigation or diagnostic purposes, cannot be made unless a method is employed that reveals the true position of the mandible in both its resting and closed positions. If a true lateral view is desired, the method of choice is laminagraphy.

The evidence seems to indicate that too much emphasis has been placed in the past on the mechanics of the joint, i.e., on condyle-fossa relationship. The opinions expressed by Robinson (1946), viz., that the *muscles* are almost solely responsible for the intricate movements of the mandible, seems to be more in accord with observations of the functioning joint.

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HEREDITY, GROWTH, AND OBSERVATION AS RELATED TO EXTRACTION PROCEDURES

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I AM privileged to discuss some considerations about the place of extraction in the treatment plan. All orthodontists are concerned with reasonable and effective treatment plans, and there are many considerations along this line which can be presented. At this time, however, I wish to talk primarily about heredity, growth, and observation as they centralize about extraction procedures. The major emphasis will center upon the benefits to be derived from attention to these factors as diagnostic aids.

In such a discussion it seems only reasonable to point out that extraction is not always of major concern in the orthodontic practice. In many cases there are obvious excesses of tooth structure as compared to the supporting bone, and we resort to the removal of teeth as the only means of bettering the situation. On the other hand, there may be too little tooth strucure, as evidenced by varying degrees of spacing, and exraction is given no consideration. In between these two extremes, however, lies a great group of the so-called "borderline deficiency" malocclusions. For these cases any estimation of the place of extraction in the treatment plan is often difficult and requires careful examination. It is problems of this type with which we are concerned.

Before initiating a discussion about some of them, let us look at the nature of our so-called "extraction procedures." It is imperative to keep in mind that the removal of teeth for orthodontic advantage is a treatment technique. As such, it is of secondary consideration in the evaluation of malocclusion. Technically it has nothing to do with the diagnosis. The removal of teeth is a part of the treatment plan. We elect to extract in the correction of malocclusion only on the basis of its contribution to the desired result, just as we select edgewise appliances over the twin arch appliances in an individual case. Accordingly, then, we do not approach the evaluation of malocclusion in terms of whether or not it is an extraction case. When we elect, as we have done here, to discuss the management of malocclusion relative to extraction, we then consider the nature of the problem in cases in which extraction is of probable advantage. We evaluate all those features peculiar unto malocclusion which make us think that extraction is indicated, or not indicated, in the treatment of it.

As we attempt to estimate the place of extraction in the treatment plan, there are many factors which must be given full consideration. We must go further than a general appraisal of the type of case with which we are dealing. Initially we are asked to provide a result which best serves the needs of the

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patient. In attempting to resolve these needs in terms of the procedures necessary to obtain them we are required to think in terms of the individual. There are no fixed postulates which indicate what an individual should be. Neither can there be preconceived ideas which dictate what we shall do to him. Rather each patient is a plan unto himself. In any consideration of treatment, then, we must recognize this plan and develop the procedures which modify the dentition according to his particular needs. There are a number of considerations which are part of the diagnosis of malocclusion relative to extraction. One of them has to do with the point of view of the patient. In an article published in the January, 1950, issue of the AMERICAN JOURNAL OF ORTHODONTICS, we discussed the significance of the patient's point of view in the development of the treatment plan. Time does not permit an extensive review of that discussion. We wish to emphasize, however, that the management of malocclusion must always adhere to adequate orthodontic service. Within limits of satisfactory management we should attempt to secure the demands of the patient and satisfy his reasons for presenting.

Dentistry as a health service seeks to prolong the life of the dentition so that the patient may depend upon his own teeth as long as he may need them. The presence of odd biting habits, highly irregular teeth, traumatic tooth relationships, and dentofacial imbalances does not contribute to these endeavors. Yet, in the removal of them we must be judicious in our approach to the problems which confront us. Accordingly, it behooves the practitioner who limits his services to orthodontics to look beyond his technical procedures as a "tooth straightener" and assume full responsibility for things that are dental if he is to gain his rightful place in the hierarchy of health services.

This fact becomes even more evident as we examine closely our function as orthodontists. It has been determined, in brief, that we are to establish and maintain the natural dentition for the purposes it serves. We can establish a number of uses for the dentition. The mastication of food, speech, and the playing of wind instruments are among them. However, without a great deal of soul-searching we will recognize in this day and age that by far the greatest contribution of the dentition is to facial appearance or esthetics. The presence of malocclusion within the dentition is not a life and death matter. The removal of it, then, can be dictated only on a reasonable basis which for the most part is psychological rather than physical. We must realize that the orthodontist is a specialist superimposed and greatly dependent upon a highly developed civilization. He deals with dentitions which are in a superior state of health, and he serves, in the majority of cases, to make a tolerable situation better.

All this does not mean that the practice of orthodontics is not important. On the contrary, in a civilization such as ours the orthodontist is assuming an ever more important role. The correction of malocclusion on the basis of appearance is becoming highly desirable in view of the demand for satisfactory facial appearance. To a lesser extent this is also true in regard to dental health. More and more the periodontist is asking for a well-aligned dentition to aid in maintaining healthy supporting structures, the restorative dentist wants straight

well-positioned abutment teeth, and the prosthodontist would rather deal with a patient who has developed masticating habits with a functionally normal dentition. But in a greater sense these too are esthetic demands since the increasing requirement of the human dentition is for the appearance.

In addition to the point of view of the patient there are other factors which often bear strongly in determining what we shall do in the way of managing the dentition. Important among them are heredity and growth. These factors are of particular importance because they dictate the nature of the morphology with which we work. It is certainly well recognized by all of us that we do not deal with fixed inanimate structures. Rather for the most part, as orthodontists, we are attempting to modify and direct the development of growing dentitions. We hope to provide a result which at the adult level is highly satisfactory for the purposes of the individual. We cannot always expect that the dentofacial complex we produce in a 10- or 12-year-old will satisfy his needs at 20 years of age. This is particularly true in the borderline deficiency malocclusions. For this reason, it is required that we give reasonable recognition to those factors which direct the final development of the dentofacial complex.

When we attempt to determine the influences of heredity and growth upon the developing dentition we must resort to techniques which permit an appraisal of these influences. The most effective method of analyzing them is through observational procedures. Observation directed at the individual provides the data which are necessary for the development of the treatment plan. By means of this technique we can appraise the various anatomical relationships about the individual with whom we are dealing.

In some cases observations about heredity and growth are more valuable than others. Sometimes sufficient data are obtained during the first examination to develop a treatment plan, and we can go ahead immediately with the necessary modifications. For example, as we analyze the significance of certain types of arch form upon treatment procedures we find this situation to be true. Arch form is one of the anatomical relationships which must be given consideration in determining the place of extraction in the treatment of malocclusion. In the paper published in the January issue of the AMERICAN JOURNAL OF ORTHODONTICS we pointed out that arch form, and by this I mean the teeth and alveolar bone, limits what we can do in our corrective procedures. Accordingly it is of major importance in the diagnosis of malocclusion to consider the significance of arch form upon treatment. In observations of this nature we find some of our greatest opportunities to determine the probabilities of aligning and spacing of teeth as against extraction and closure of space. Here it was noted that there are a number of variations in arch form which can be observed within the human dentition. Some observers define six, namely, the tapered, the trapezoidal, the ovoid, the U-shaped, the hyperboloid, and the squared. The last two types are rarely seen. For this reason we shall limit our discussion to those types most usually encountered in the practice of orthodontics. They are the tapered, the trapezoidal, the ovoid, and U-shaped arches. The opportunities for the management of the full complement of teeth vary within each type. The tapered

arch is at one extreme in this classification. It is illustrated by the casts in Fig. 1, *A*. As shown here, the tapered arch converges from molars to central incisors to such an extent that lines passing through the central grooves of the

A.

B.

Fig. 1.—Casts illustrating the possibilities for the management of malocclusion in the tapering arches.

molars and premolars intersect a short distance anterior to the central incisor. An occlusal view of the maxillary cast in this figure reveals the teeth present to be in good relationship to the supporting bone. The incisors are somewhat

irregular. The canines bulge the mucosa and are about to erupt. However, the spaces available to them are inadequate for proper alignment. There is no opportunity for these teeth to assume their position in the dental arch. In spite of all this, it is possible through treatment procedures to make room for the canines in this dentition. By expanding the molars and premolars and by flattening out the anterior teeth in a labial direction, it would be possible to align the teeth in this jaw. On the other hand, the nature of the dental arch created would be far different from that of the supporting bone. Without retention we would have a gradual change of the teeth back to a shape in keeping with the basal bone. In this insatnce then there was no opportunity for alignment of all the teeth in this dentition. For the most part, whenever there is an excess of tooth structure over supporting bone in the long tapering arches, this conclusion holds true. There is little chance for manipulation of the dentition into a stable pattern. Accordingly, we think in terms of extraction procedures in the management of the malocclusions superimposed upon these types of supporting structures. In the case shown here as demonstrated by the casts in Fig. 1, *B*, four premolars were extracted. In the upper arch the erupting canines have moved into adequate space. There was no need to await the completion of the permanent dentition to make this diagnosis. The basic arch form was fixed, and modification of the dental arch during the growing period was indicated.

Whenever we can make early and definite diagnosis of the type illustrated in Fig. 1, *A* and *B*, we have great opportunities for the management of malocclusion. By timing and spacing our extraction procedures in keeping with the growth rate of the individual, we can often reduce the treatment period. In addition, the appliancing is easier and occasionally unnecessary.

At the other extreme in the classification of arch form, namely, the U-shaped arches, a similar situation holds true. Again in dentitions of this nature often the data are sufficient to enable the development of a treatment plan without driving deeper into the etiological background of the patient with whom we are dealing.

A nearly U-shaped arch is shown by maxillary occlusal view in Fig. 2, *A*. The U-shaped arches present little difference in diameter between the first premolars and the last molars. The curve from canine to canine is so abrupt that a capital "U" is formed. For the most part these arches are not commonly observed in our population. The arch here is not a typical "U" type. It is intermediate between a trapezoidal and U-shape. Yet it demonstrates the probabilities which are associated with the latter type. In the U-shaped arches the jaws are usually large and the alveolar bone massive. Whenever problems involving irregular teeth occur within arches of this nature, there is great opportunity for aligning and spacing. We seldom think in terms of extraction. Again the case shown in Fig. 2, *A* and *B* presents an example of treatment under these conditions. In the maxillary arch in Fig. 2, *A* there is irregularity of central and lateral incisors. The patient occludes so that the right lateral incisor is in cross-bite with its opponent. As illustrated this tooth has grown lingually into

the palate. The left central and lateral incisors bite end-to-end and partially in cross-bite with their opponents. The mother stated that the patient was troubled by too long retention of deciduous incisors. With the exception of the maxillary right central incisor all permanent upper incisors erupted lingual to their deciduous teeth predecessors. In each case the deciduous teeth had to be extracted after the permanent tooth had come into the mouth. The mother had large jaws and well-aligned teeth. The father had a functional anterior cross-bite in which the mandible was not excessive in size over the maxilla. In addition, all of his teeth were well aligned. This background is typical of malocclusion in the U-shaped arches. Irregularity is of local rather than of deep-seated causes. For this patient, after less than six months' treatment, as shown in Fig. 2, *B*, the cross-bites are corrected and the maxillary incisors are occluding nicely against the well-aligned mandibular incisors. The canines are slowly erupting into adequate space. There has been no arch expansion. The remaining treatment procedures will be directed to give the anterior teeth a little more character while the canines are completing their eruption.

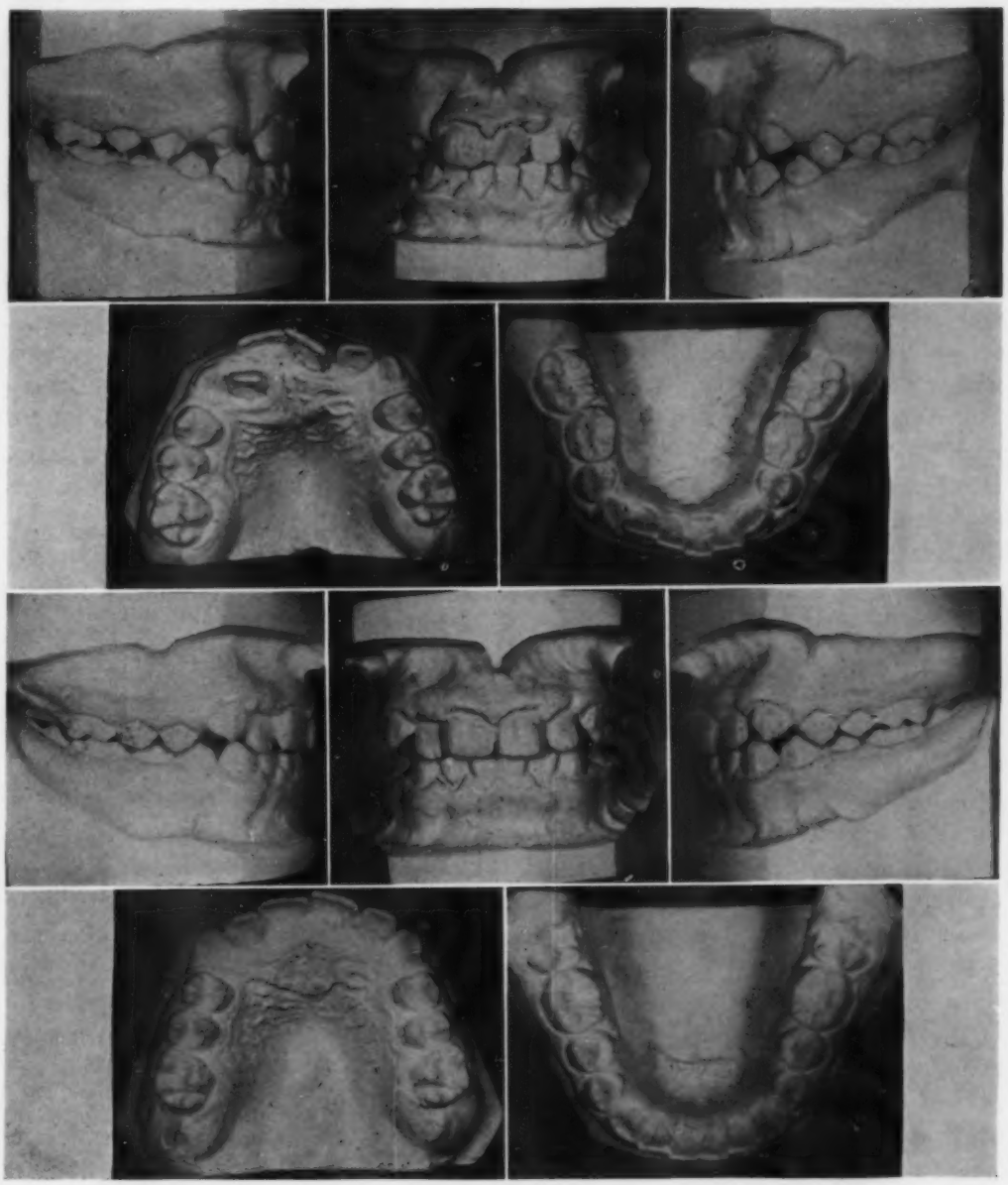
On the other hand, in a far greater number of cases with which we deal the morphology is not always clear-cut. The development of a suitable treatment plan is not always easy. In these situations it is necessary to provide more data in order to understand fully the nature of the cases with which we are dealing. Here we resort to more extensive and more refined observation.

There are all kinds of observational techniques. They may involve angular measurement from cephalometric appraisals or consist of the collection of a series of casts taken of the individual over a period of time. No matter what observational techniques are used, however, it is necessary that we recognize our professional responsibility and exercise high skill in the selection of them. Referring again to the patient's point of view, he expects our ability to be such as to know what the real needs are along these lines, in order to avoid unnecessary costs in data collection. The patient wishes to pay for treatment, not for our experimentations. He expects the practitioner to use his knowledge to avoid unnecessary orthodontic procedures whenever possible. Often simple observational procedures conducted at an early age will provide us with the necessary information about the growth and development of an individual, so that many times we can distinguish between excessive and necessary data collected at the time of treatment. Angular measurements of the jaws and skull, or elaborate recordings with gnathostatic casts may be excellent in some cases. They may be absolutely unnecessary in others.

Now as we make observations about the inheritance of an individual we derive little value from studying the general pattern of heredity. Because of the random dispersement of genetic patternings we have no idea what combination of features an individual will inherit. Before we can think in terms of heredity, then, it is necessary to look at the patient to determine that nature of his problem. When we find that there is some relationship within his dentofacial pattern which has to do with a particular irregularity which is undesirable to him we can refer to the hereditary implications. We can look at other mem-

bers of the family to get an idea about the development of the particular point in which we are interested. So before heredity can be of value to us we must know what points of the inheritance are manifest in the individual. Accordingly,

A.



B.

Fig. 2.—Casts illustrating the possibilities for the management of malocclusion in the U-type arches.

we direct our observational attention toward understanding the particular problem within the patient. In this way we can obtain evidence which permits the formulation of a better treatment plan. To illustrate this point, let me refer

again to our discussions about arch form. Between the two extremes of the tapering and U-shaped arches, there are the trapezoid and ovoid arches. Here the analysis of arch form as an aid in determining the need for extraction or nonextraction is more difficult. Sometimes in the growing child there are minor developmental tooth movements which distort the pattern of the dental arch. In others the data are too inadequate to permit a final appraisal. Yet our obligation as orthodontists requires that we be considerate in the management of malocclusion and direct our efforts to the best interests of the patient.

As our evidence accumulates it is becoming apparent that within the limitations of growth the apical base is a fixed relationship. To a less extent this is also true of the alveolar bone. The alveolar bone can be directed somewhat during the growth period. In addition, we can reduce it and we do when we extract. On the other hand, we cannot replace it once it has been destroyed, and herein lies the crux of the extraction problem. As dental practitioners, we are obliged not to destroy tissue unless this loss is highly beneficial to the patient who sustains it. We cannot sidestep this responsibility and maintain our position as a responsible professional group. Fortunately, the dental arch is more variable. It can be modified within the limits of its supporting alveolar bone. If lost we can replace it. With appliances we can align almost any combination of dental irregularity. Experience, however, has taught us that when we shape the dental arch to a form which varies greatly from that of its supporting alveolar bone and apical base, our modification is not a stable one. Thus we are obliged to work within the confines of the individual arch form.

In developing treatment plans for the trapezoidal- and ovoid-shaped arches, observations about inherited patterns of the individual are of great value. The occlusal views of the maxillary arches in Fig. 3, *A* and *B* show a trapezoidal arch. In form they converge in variable degrees from molars to canines and are abruptly rounded from canine to canine tip. The maxillary cast in Fig. 3, *A* shows a slight variation from the one in Fig. 3, *B*. Looking at it from the occlusal we realize that this arch is not as clearly defined as the lower one. On the left side where the deciduous canines and molars are present there is definite inclination to the narrow tapering arch form. On the opposite side where the first premolar is partly erupted the nature of the arch is different. This is not unusual. Barrow and White,[1] in a report presented at the 1944 Research Section of the American Association of Orthodontists, indicated that there are noticeable changes in the shape of dental arches during their development from the primary to the permanent dentition. In our classification the trapezoidal arches are only one step broader than the tapering types. Yet we already note by the position of the erupting first premolar in the maxillary cast in Fig. 3, *A* that the potentiality for a wider dental arch is present. Here, however, our circumstances are somewhat different from those within the tapering arches. As indicated by our definition, the trapezoidal arch has greater width at the canine and premolar areas. Accordingly we have more room for the manipulation of dental units. Whenever there is a borderline deficiency relationship between the teeth and the supporting bone we have license to attempt the reorganization

of the dentition for a stable result. If the patient does not demand idealism we can almost always provide a dentition which satisfies his needs without resorting to the risks and obligations of extraction procedures. The case in

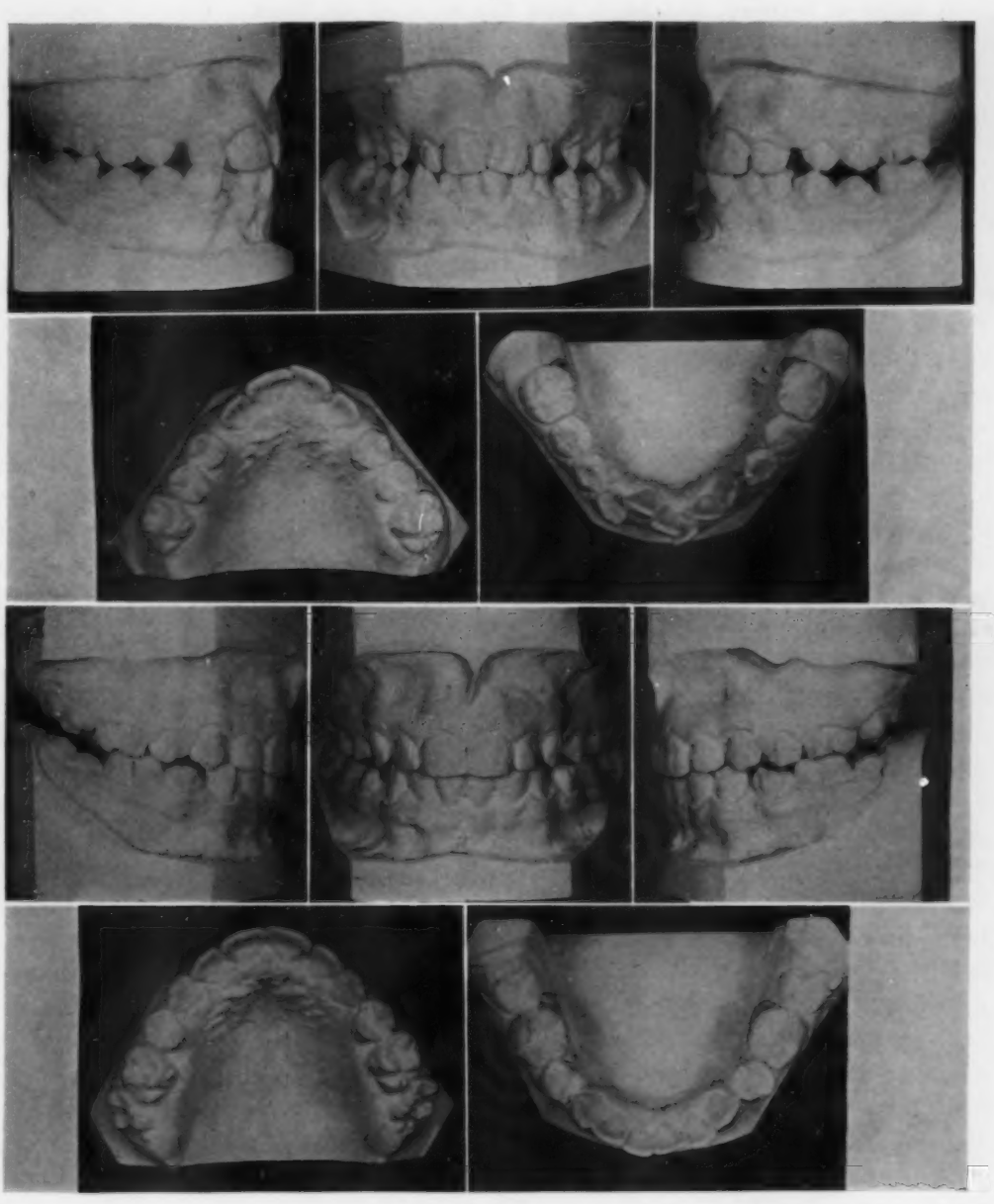


Fig. 3.—Casts illustrating the possibilities for the management of malocclusion in the trapezoidal arches.

Fig. 3, *A* and *B* illustrates this point very well. As demonstrated by the casts in Fig. 3, *A* there are deficiency factors present in this individual. A critical examination of the supporting bone, however, suggests that the dental align-

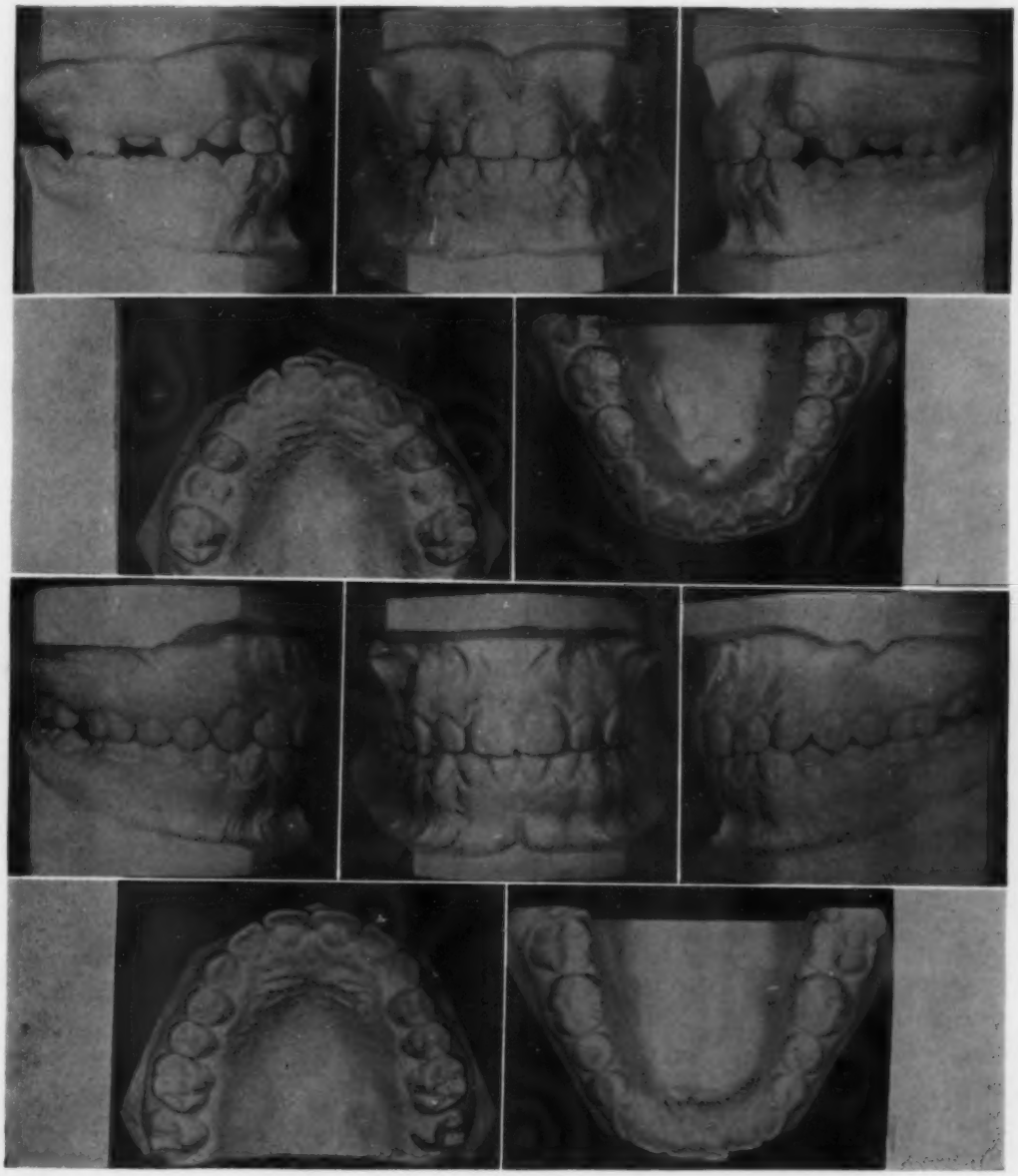
ment belies the probabilities for support of the teeth. Because of these probabilities the treatment of this dentition was directed along lines to develop the trapezoidal arch. The result is shown in Fig. 3, *B*. Whether you like it or not, you will agree that there is no excess of supporting structure. There is a very close balance between the teeth and the supporting bone. Without creating additional space little more can be done for this patient in the way of tooth alignment. Yet this individual, by his own testimony and that of his parents, has a satisfactory dentition which serves his purposes well.

Now the management illustrated by this case was not suggested entirely by the relationships observed here. As in all cases there were other diagnostic data which helped to indicate the nature of the treatment plan. Several years previous to the treatment of this patient an older brother had received a similar correction. The older brother's dentition was quite like the one shown here. The treatment procedures were also the same and the end result had held up amazingly well. When the second boy presented for treatment, it seemed only reasonable to expect that he, too, might receive a favorable correction without resorting to the removal of teeth. At this time the mother and father were also examined. The examination revealed that both parents had medium-width arches, one trapezoidal and the other ovoid in nature. In addition, there was no highly objectionable dental irregularity in either parent. On the basis of these findings, treatment for the second boy was initiated without creating more space. Here, as in our earlier consideration of growth changes of the dental arch, the result shown is neither unusual nor unexpected. Moore and Hughes,[3] in their report on "Familial Factors in the Diagnosis, Treatment, and Prognosis of Dentofacial Disturbances," pointed out the extensive operation of heredity in the production of features in the dentofacial complex. They exphasized that the most important contribution hereditary knowledge makes to diagnosis is in the outlining of expectation for the growing child. They added that this is particularly true in those portions of the face which are markedly influenced by age. They advised that we can be guided in our efforts to estimate the opportunities for aligning and spacing of teeth within the supporting structures. In their analysis of arch form we note that arch form is strongly dependent upon hereditary circumstances, with a general dominance of narrow or constricted arches over broad ones. Thus, if we know whether one, the other, or both parents present constricted arches, we are provided with a considerable body of evidence about the probable course of the development of the child. When the long tapering arch is present in one or both parents, we do not try to develop the dental arches to greater limits. The probabilities that we can get away with it are remote and we resort to extraction procedures on a reasonable basis. On the other hand, when we see medium to large dental arches in both parents we are more optimistic. We can consider aligning and spacing in terms of favorable results.

The same type of appraisal is of value in estimating the ovoid arches. An example of an ovoid arch is shown by the maxillary cast in Fig. 4, *B*. Here the arch curves continuously from the molars on one side to the molars on the

opposite side in such a way that two casts placed back to back describe an oval. In the ovoid arches there is greater opportunity for the alignment of all teeth than in the trapezoidal forms. Often it is possible to round out the dental arch

A.



B.

Fig. 4.—Casts illustrating the possibilities for the management of malocclusion in the ovoid arches.

and still stay within the confines of the supporting bone. Again, the models shown in Figs. 4, *A* and *B* demonstrate these possibilities. The casts in Fig. 4, *A* were taken before treatment. The right maxillary canine is erupting into

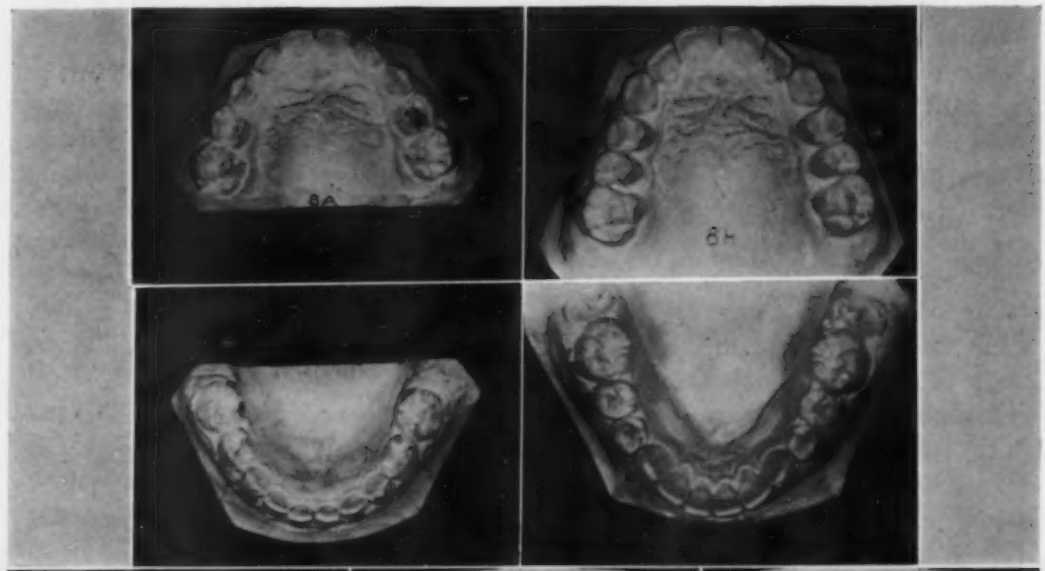
adequate space. The second premolars also appear to have room for eruption. The left central and lateral incisors are distally posed as compared to the position which the right incisors have assumed. In this case the dental arch has trapezoidal characteristics. Yet the alveolar bone has a greater potentiality to support than is indicated by the alignment of teeth. On the basis of this probability treatment was planned without extraction procedures. The result is shown in Fig. 4, *B*. The premolars were expanded slightly and the left side of the arch was elongated and rounded out. In this case the plan of treatment was again supported by hereditary data. The mother had a large trapezoidal arch and slight dental irregularity. The father had a medium-sized ovoid arch with teeth rounded out in good alignment. Had there been a definite deficiency malocclusion in either of the parents, we would have followed our first inclination which was to extract.

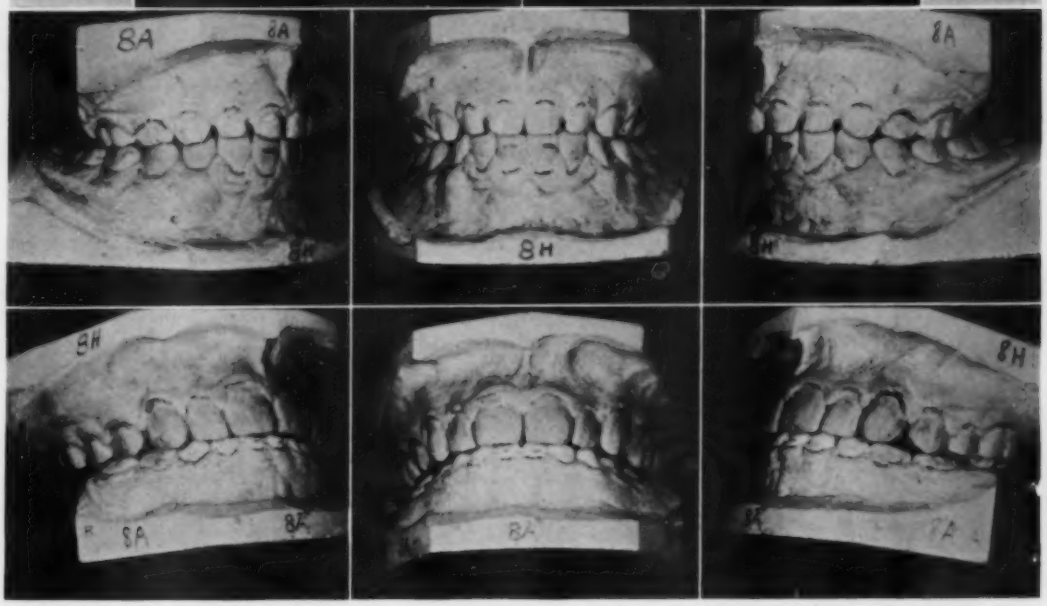
Now sometimes the use of almost any type of diagnostic aid is of little value in the appraisal of the borderline deficiency malocclusions. In some cases even the collection of systematic records over a period of time does not provide the necessary information about a case we do not understand. In these situations we can resort to treatment itself as an observational technique designed to tell us what we can expect in the way of response from the individual. Often we would like to explore the possibilities of managing a full complement of teeth before resorting to extraction in the treatment plan. Here the use of palliative treatment techniques to test our diagnoses is a warranted and reasonable procedure. Before committing ourselves to extraction, from which there is no recovery, we can space and align in an effort to determine if the supporting bone can accommodate the teeth that are present. At first this suggestion may seem overcautious. Yet, I think we will all agree that a treatment plan which is based on a tested diagnosis is far safer and more comfortable to both patient and operator than one which is confounded by the promiscuous use of extraction and the sickening realization that we have removed too many teeth for the good of the patient.

In this discussion we have emphasized that heredity aids considerably in understanding the nature of the dental arch and that such an understanding is of major importance in the diagnosis of malocclusion relative to extraction. In addition to this consideration, there are a number of facts about the growth and development of arch form which are of great interest from a clinical point of view. To begin with, it is quite probable that the lateral growth in the anterior position of the dental arch ceases at a very early age. On the basis of the observations made on serial casts collected at the University of Michigan Elementary School, it appears that when the spacing between the primary incisors stops increasing, the arch width is probably complete. Developmentally, of course, exfoliation of the primary incisors may obliterate these details. In any case, however, it can be observed in all of these long series of casts that the primary dental arch of any individual will almost exactly occlude with the opposing arch of the same individual in the adult dentition. Were it not for

the larger size of the permanent teeth this "fit" would be almost perfect. An example of this relationship is shown in Fig. 5. That this relationship can be established is an indication of several facts. Aside from a slight amount of oppositional bone growth associated with the larger permanent teeth, there is little or no change in anterior arch size from the primary to the permanent

A.





B.

Fig. 5.—Casts illustrating the comparative arch size and shape between primary and early permanent dentitions in the same individual. *A* shows the occlusal views of the primary and permanent arches. Note the striking similarity in arch shape between the primary and permanent dentitions. *B* shows the "fit" of the primary maxillary dental arch to the permanent mandibular dental arch, and the permanent maxillary dental arch to the primary mandibular dental arch.

dentition. Apparently the widening of the jawbone which supports the dental arch is intersutural in nature and it ceases by the time of the loss of the primary dentition.

Now, thinking back in terms of the arch shapes we have already discussed, it is noticeable that arch form is characterized by the position of the second and third molars. In many cases it may be easier to determine the nature of the arch with which we are dealing after the eruption of these teeth. On the other hand, the knowledge that there is little or no change in the shape of the anterior portion of the dental arch is of value in anticipating treatment probabilities. When the patient has narrow constricted dental arches in the primary dentition we know the replacing teeth will occupy the same position. Dr. Hays Nance recognized this fact and developed a technique for measuring this relationship. These measurements become useful and powerful diagnostic aids when supplemented by observations about growth and heredity taken from the individual. On the other hand, the presence of broad arches in the patient in the primary state of development suggests that adequate space for the permanent dentition is forthcoming. In any case, however, the observations about growth supplement the observations about heredity. Together they provide a considerable body of data for prognosing the development of the individual dentition. Such information provides indications of excesses or deficiencies of supporting structures and enables us to anticipate the management needs of the patient. In true deficiencies we can plan to remove teeth at a time most suitable for balancing the tooth and jaw relationship with a minimum of treatment. In the borderline deficiency malocclusions we can initiate early directional controls in an effort to reduce extraction needs at a later time.

In closing I would like to re-emphasize three items which merit your consideration:

1. The need for a conscientious development of a reasonable and professional treatment plan by the practitioner.

2. The use and collection of observations focused primarily about those reasons for which the patient submits himself for treatment.

3. The extreme value of resorting to observation, whether these observations be derived from the heredity of the individual, the growth of the individual, or the detailed dentofacial morphology of the individual, whenever further and better decisions need be developed in plan or in treatment.

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UNERUPTED OR IMPACTED MAXILLARY CUSPID

Report of a Case

Walter J. Sly, D.M.D., Boston, Mass.

THE purpose of reporting this case is to illustrate a method of handling the problem of the unerupted or impacted maxillary cuspid.

The patient was a girl 14 years, 4 months of age, of rather slight build. The teeth and jaws were quite small and the molars were in neutroclusion (Fig. 1). Both III | III were present and 2 | congenitally missing with 3 | in position directly above the 2 | space. | 3 was lying as will be seen in the x-ray.

The only significant points in the history were the congenitally missing lateral incisor and the prolonged retention of the III | III.

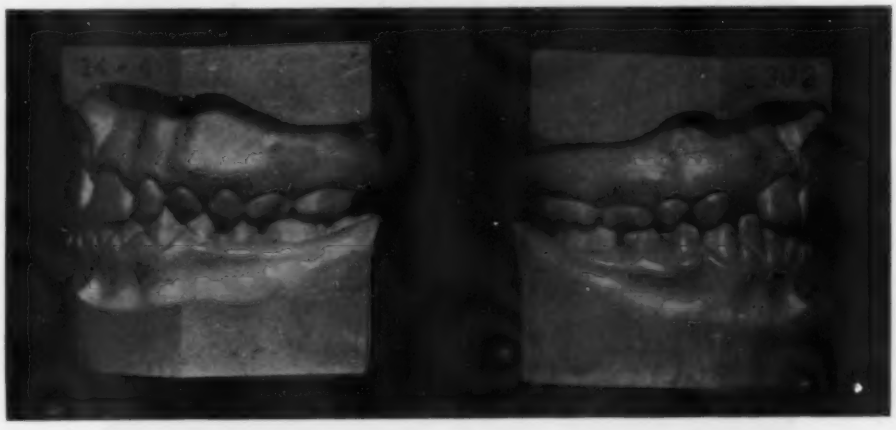

Fig. 1.—Original model, left side; original model, right side, 2 | congenitally missing.

The prognosis was considered to be fairly good since the x-ray (Fig. 2) showed no sclerotic periodontal membrane and the | 3 was accessible although in rather close contact with the | 2. The right side was operated first, the III | being removed and attachment applied to the 3 |. The 3 | erupted into the 2 | space (Fig. 3). The permanent canine was then moved into its normal position and a lateral facing added to the lingual wire to maintain the space and for esthetic reasons. It was decided to supply the 2 | rather than distribute the space because of the diastema which already existed between the 1 | 1. The | 3 was then exposed and the attachment cemented in place.

The tooth is exposed by means of a flap operation and sufficient bone is removed to uncover the crown completely. It is, however, advisable to maintain

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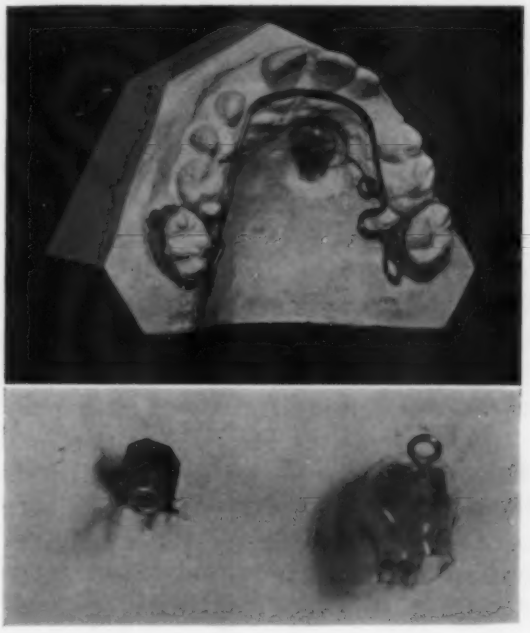
Fig. 2.—Lateral jaw x-ray, left side, | III in position; | 3 palatal to | 2 ; right side, III | normal position; 3 | in 2 | space.

Fig. 3.

Fig. 4.

Fig. 3.—Occlusal view x-ray, $\underline{|3}$ palatal to $\underline{|2}$ in contact with $\underline{|1}$.
Fig. 4.—X-ray showing $\underline{|3}$ being moved distally and downward. Perforated material with ring attached to spring. Also crown-form.

A.



B.

Fig. 5.—Technique model showing method of attachment to lingual wire. *A*, Ring with anchor plate. *B*, ring and crown-form assembled.

the labial plate intact if possible in order that the tooth may be well supported and the gum line assume a normal appearance. As soon as the wound was partially healed a spring was applied to guide the tooth into position, using very light spring force. The tooth erupted into the palatal position and was guided away from | 2 to a position opposite the space (Fig. 4). It was necessary to apply a rotation band to complete the positioning of the tooth as it was moved through the space.

Various methods have been used to bring about the eruption of these teeth. The usual technique of some years ago was to expose the tooth and pack with gutta-percha to keep the wound open. If the tooth did not then erupt a pin with ring was cemented near the tip and traction applied. Various means of attachments have been employed which used cast overlays and others which consisted of wire loops set in a mass of copper cement. A later method developed by Dr. Moses Strock utilized a celluloid crown-form attached to the tooth by means of zinc oxide or similar paste. The contraction of the tissue around this form during the healing process caused the tooth to erupt.

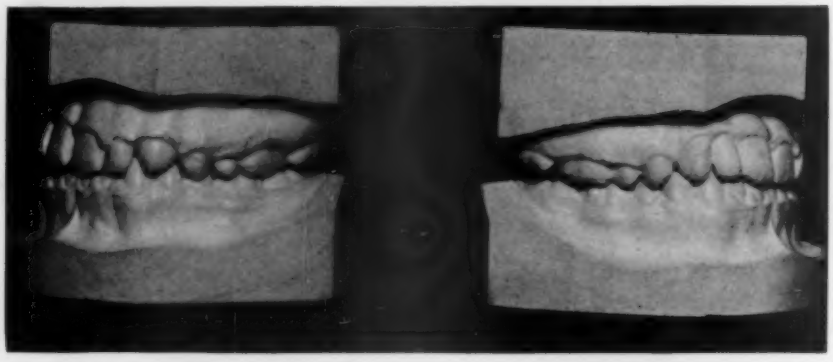


Fig. 6.—Final model, Left side shows | 3 in position. Right side shows 3 | in position with 2 | facing on lingual wire. Diastema closed.

The attachment which I used in the treatment of this case consisted of a crown-form as used in the Strock operation, and in addition a piece of very thin band material perforated and soldered to a small ring and inserted through a slot in the form. When this is tried on the tooth the metal adapts easily to the surface and is then cemented with Tenacin or some similar sticky cement.

The perforations engage the cement and anchor the ring into position (Fig. 5, *A* and *B*). I believe that this method combines the advantages of the pin and ring technique with those of the Strock operation in that it is less trying to the patient than the pin and ring technique, since its application requires no drilling and is finished while the area is still under anesthesia; and also since there need be no delay in applying traction if the tooth lies deep or in contact with another tooth (Fig. 6).

60 CHARLESGATE WEST.

CLINICAL STUDIES IN THE DEVELOPMENT OF THE DENTAL HEIGHT

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A GREAT deal has been written about the development of dental height. For a long time it was thought that with the eruption of the teeth there is wedging apart of the maxilla from the mandible, and that the increase in height occurs by vertical growth of the face, as well as from the combined height of the crowns of the teeth which separate the two jaws.[1, 2, 3, 4, 5, 6, 7]

Diamond[8] described the dental height as the sum of the portions of the jawbone within which teeth are developing; this included the teeth in their later varying states of eruption. The dental height can be observed when the teeth are in centric relation and should not be confused with the physiologic rest position which has been so well described by Thompson and Brodie.[9, 10]

The development of the dental height in the early years of life, according to current concept, is brought about by the downward growth of the temporal bone[11, 12] and by some growth of the ramus length. Together, these contribute to the lowering of the mandible. Intermaxillary space is thus provided for the eruption of the deciduous teeth. Thereafter, intermaxillary space for the subsequent eruption of the permanent teeth is determined by growth of ramus length. Apposition of bone at the crests of the maxilla and the body of the mandible results in vertical growth of maxilla and mandible.[13] Later, the ramus length increases, providing the intermaxillary space required for the eruption of the succeeding permanent teeth.

The occurrence of spatial interrelation continues until all the teeth have erupted with the maxilla and the body of the mandible reaching their fullest development. When interference with this biologic phenomenon occurs, either from disease or other influences, a change in the positional arrangement of the teeth and retardation in the growth of the jaws can be anticipated.

METHOD OF STUDY AND OBSERVATIONS OF CASES

Growth and development of teeth and jaws were studied clinically and radiographically. Impressions of the jaws were taken annually whenever possible, to observe the size of the teeth, arch growth, increase in size of the jaws, and the occlusal relations of the teeth.

Impressions taken on all the children in this study included those of the edentulous gum pads posterior to the last erupted tooth. The casts were made so that they could be articulated in centric relation. By comparing annual casts, the intermaxillary space could be observed and the vertical growth of the maxilla and mandible could be seen. The growth of the arches was measured by a modified method suggested to Braun[14] and Cohen.[15]

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Studies were made on two children with ectodermal dysplasia. One male child had complete anodontia; he was observed from 5 years of age to the age of 8. The second, a girl with ectodermal dysplasia, had partial anodontia; she was studied from 2 years, 8 months to 8 years, 3 months. Observations were also made of two young pituitary dwarfs.[16] The younger was observed from 2 years, 9 months of age to 10 years, 1 month; the older, from 15 years, 1 month to 19 years, 1 month. Both dwarfs received intermittent treatment with growth-stimulating hormones during the period of dental observation. Two normal children who had teeth absent in their jaws were also studied. The youngest of these was 3 years, 6 months old, and was first seen at the age of 2 years, 5 months. Clinical and radiographic examination revealed absence of the deciduous maxillary right and left lateral incisors, as well as deciduous mandibular right and left central and lateral incisors. Casts of his mouth were made at 2 years, 5 months of age and again a year and a month later, when he was 3 years, 6 month old.

The second child, 5 years, 7 months of age, was first seen at the age of 9 months; he showed two mandibular peg-shaped incisors. Radiographic examination at this time revealed two deciduous maxillary atypical central incisors with absent deciduous maxillary right and left lateral incisors and right and left maxillary cuspids. The mandible showed an absence of the right and left deciduous lateral and cuspid teeth on x-ray examination. Casts of the mouth were made at the ages of 9 months, 2 years, 5 months, and 3 years, 10 months.

Fig. 1.—Case 1. Photographs of R. F. with ectodermal dysplasia at the age of 5 years. (Courtesy of the Forsyth Dental Infirmary and Dr. Kurt H. Thoma.)

DENTAL HEIGHT OBSERVATIONS IN ECTODERMAL DYSPLASIA

CASE 1.—R. F. (Fig. 1, Case 1), boy, aged 5, was first seen at the Forsyth Dental Infirmary[17] and presented the classical features of ectodermal dysplasia (anhidrotic type) with complete anodontia. Casts of his mouth at the age of 5

(Fig. 2, *A*, Case 1) showed a maxilla and a mandible which were well developed in size, both anteroposteriorly and laterally, and gave the appearance of an edentulous maxilla and mandible. The maxilla and mandible at the age of 5 compared favorably in size with those of two normal children of the same

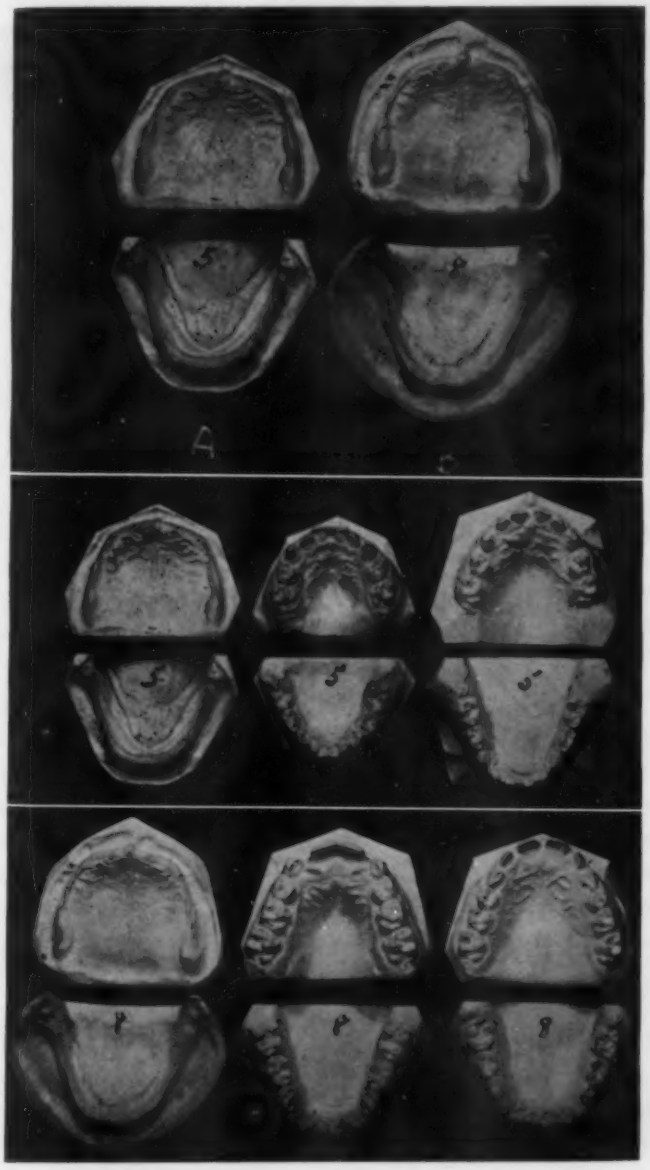

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 2.—Case 1. Maxillary and mandibular casts of R. F. with ectodermal dysplasia at the ages of 5 and 8. *A*, 5 years; *B*, 8 years.

Fig. 3.—Case 1. Casts of R. F. with ectodermal dysplasia at the age of 5 years, compared with casts of two normal children at the age of 5.

Fig. 4.—Case 1. Casts of R. F. with ectodermal dysplasia at the age of 8, compared with casts of two normal children at the age of 8.

chronological age, who had full complements of teeth (Fig. 3, Case 1). Three years later, after having worn dentures for two years, casts were made of the mouth at the age of 8 (Fig. 2, *B*, Case 1); again growth was evident antero-

posteriorly and laterally. The casts of the jaws at the age of 8 in ectodermal dysplasia compared favorably in size with two normal children of the same chronological age, who had full complements of teeth (Fig. 4, Case 1).

The dentures which were worn by this boy for two years proved satisfactory, both esthetically and functionally. The temporomandibular articulation appeared normal, suggesting that the ramus length growth is not interfered with in ectodermal dysplasia with complete anodontia and that the jaws develop independently of the teeth. These observations are in agreement with the findings of Diamond,[8] and Brodie and Sarnat.[18]

Case 2.—V. M., girl, white, aged 8 years, 3 months, was first seen at the age of 2 years, 8 months[19] (Fig. 5, Case 2). Oral examination revealed a maxilla which had two atypical canine teeth and two partially erupted molars. The mandible had two peg-shaped incisors and two atypical canines (Fig. 6, Case 2). The finger- and toenails were convex and poorly developed, but no other ectodermal structures showed abnormalities. Roentgenographic survey of the mouth at this time showed only 4 teeth in the maxilla and 9 teeth in the mandible (Fig. 7, Case 2). The carpal development was consistent with the patient's chronological age, and she was normal in all other respects. A diagnosis of ectodermal dysplasia with partial anodontia was made. Casts of the mouth at the age of 2 years, 10 months (Fig. 8, *A*, Case 2) showed that 8 teeth had erupted. When the casts were articulated, the mandible appeared prognathous; and a photograph of the face shows the prominent chin (Fig. 5, Case 2). There was no appreciable intermaxillary space at this time (Fig. 8, *A*, Case 2).

Casts of the mouth one and one-half years later, when this child was 3 years, 6 months of age, showed 10 erupted teeth. When the casts were now articulated in centric relation, a definite mandibular prognathism was revealed (Fig. 8, *B*, Case 2). This could be accounted for genetically since both her mother and grandmother were prognathous. Lateral views of the casts showed the development of an intermaxillary space. Since it was physically impossible for the anterior teeth to wedge the jaws apart because of missing maxillary incisors, this space was apparently created by the downward growth of the temporal bone, together with an increase in ramus length, which created sufficient space for the molars to erupt. Further observation of casts at the age of 4 years revealed a further progression of the prognathism when casts were articulated in centric relation. Lateral views of casts showed an increase in the height of edentulous pads posterior to the molars in both the maxilla and the mandible (Fig. 8, *C*, Case 2). At this time, it appeared that the ramus length growth had been retarded and the crest of the maxilla and the body of the mandible had filled in with bone. Approximately one year later, at the age of 5 years, 1 month, casts in centric relation again showed a very definite mandibular prognathism with overerupted peg-shaped incisors in the mandible. Lateral views of the casts again indicated ramus length growth, since the intermaxillary space had increased. The maxilla showed some evidence of growth anteroposteriorly and laterally, and growth of the mandible anteroposteriorly

and laterally could be observed (Fig. 8, *D,* Case 2). Examination of casts at the age of 7 years, 5 months showed some anteroposterior development of the maxilla, and the intercuspid width in the maxilla had increased. The mandible

Fig. 5.

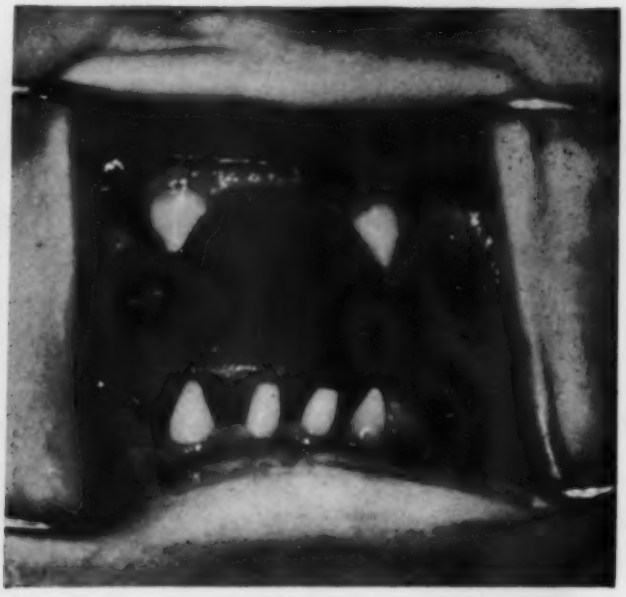

Fig. 6.

Fig. 5.—Case 2. Photograph of V. M. with ectodermal dysplasia at the age of 2 years, 8 months.

Fig. 6.—Case 2. Partial anodontia and peg-shaped teeth in ectodermal dysplasia.

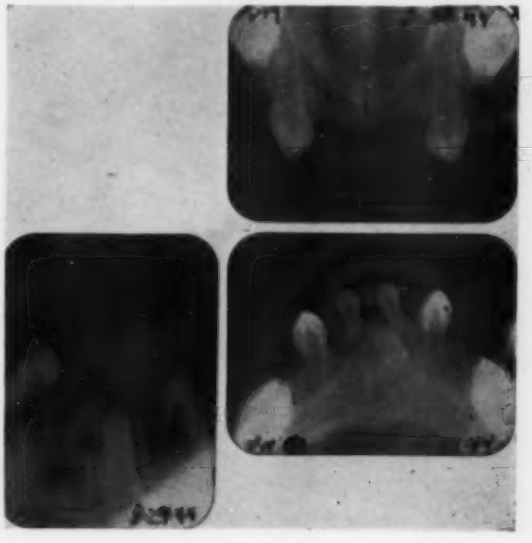

Fig. 7.—Case 2. Intraoral roentgenograms in ectodermal dysplasia.

was now definitely prognathous with overrupted peg-shaped teeth in the anterior portion (Fig. 8, *E,* Case 2); this is in agreement with the findings of Sicher.[20]

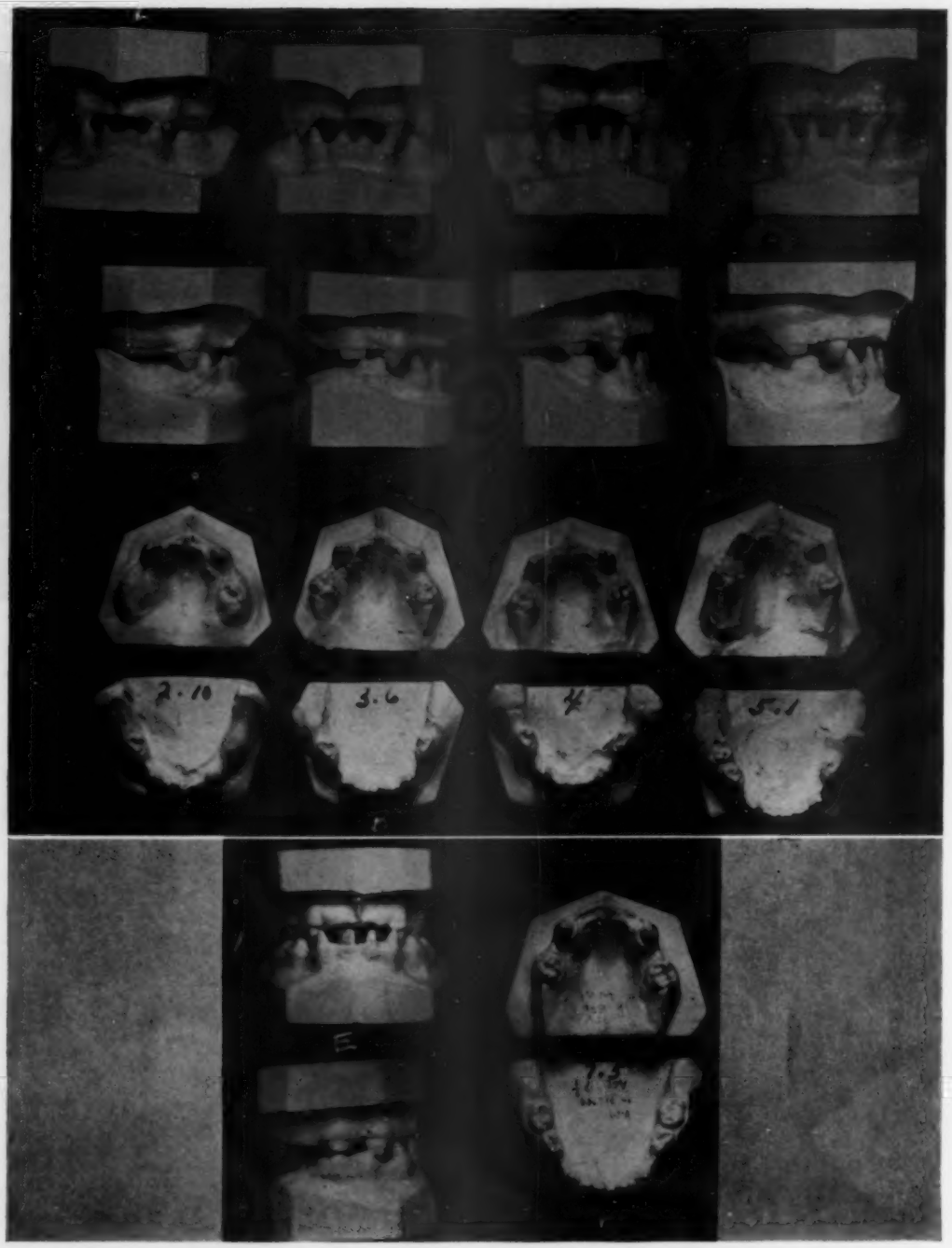

Fig. 8.—Case 2. Maxillary and mandibular casts of V. M. from the age of 2 years, 10 months to 7 years, 5 months: *A*, 2 years, 10 months; *B*, 3 years, 6 months; *C*, 4 years; *D*, 5 years, 1 month; *E*, 7 years, 5 months.

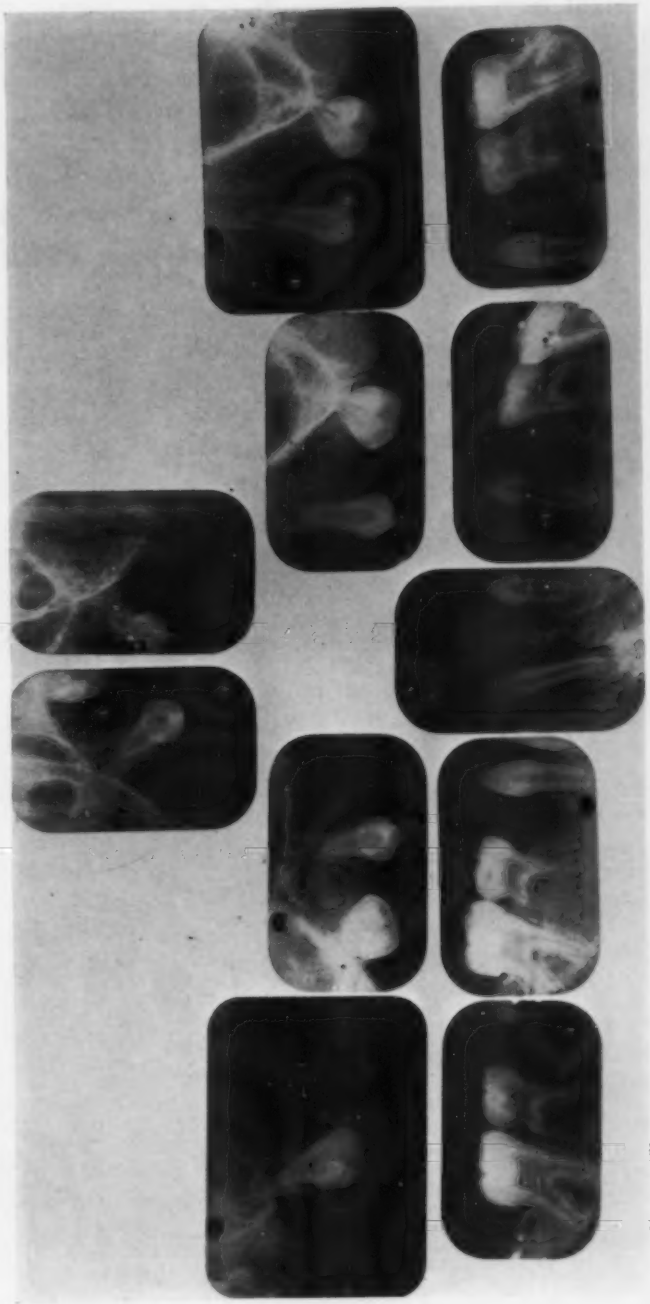

Fig. 9.—Case 2. Intraoral roentgenograms of V. M. with ectodermal dysplasia at the age of 7 years, 5 months.

These observations indicate that in ectodermal dysplasia with partial anodontia, the jaws develop normally anteroposteriorly and laterally with the downward growth of the temporal bone and the ramus length growth creating the intermaxillary height early in life. Thereafter, the ramus length growth provides the intermaxillary space into which the teeth erupt. A complete intraoral x-ray examination at the age of 7 years, 5 months revealed normal bone development with no alveolus in the edentulous areas (Fig. 9, Case 2). There remain, however, two edentulous areas in which the bone does not appear normal. It is suggested that degenerative epithelial remnants in early tooth development might account for these findings. Biopsies of these areas at an appropriate time should prove interesting.

DENTAL HEIGHT OBSERVATIONS IN PITUITARY DWARFISM

CASE 3.—W. T., boy, white, aged 10 years, 7 months, was first seen at 2 years, 9 months, when a diagnosis of pituitary dwarfism was made clinically and radiographically. A general retardation of skeletal development, as well as hypogonadism, was manifested. This patient received growth-stimulating hormones intermittently during his dental observation, from 3 years to the age of 10 years 7 months.

Casts of the mouth at the age of 3 years, 6 months showed a full complement of deciduous teeth. When the teeth were articulated in centric relation, a moderate overbite could be observed. Lateral views of casts showed the posterior gum pads of the maxilla touching the gum pads of the mandible with no intermaxillary space (Fig. 10, *A*, Case 3). Casts of this patient, made at the age of 4 years, 2 months (Fig. 10, *B*, Case 3), 5 years, 5 months (Fig. 10, *C*, Case 3), 6 years, 5 months (Fig. 10, *D*, Case 3), and 7 years, 5 months (Fig. 10, *E*, Case 3), showed some increase in the overbite in centric relation. Lateral views revealed no increase in intermaxillary height from the age of 3 years, 6 months to 7 years, 5 months. The maxilla showed some growth posterior to the last erupted deciduous molar. No growth was apparent in the mandible in the canine region, and some posterior growth could be seen distal to the last erupted deciduous mandibular molar. The failure of the intermaxillary height to develop could be attributed to an arrest in the ramus length growth because of generalized osseous retardation of skeletal development, a manifestation of pituitary dwarfism. The failure of the intermaxillary space to develop in this case inhibited the vertical growth of the alveolar processes in both jaws, retarding markedly the eruption of the permanent teeth. Since there was little change in the arch form and size of the maxilla and the mandible, an interference with the positional arrangement of the permanent incisors could be seen at the age of 10 years, 1 month (Fig. 10, *F*, Case 3). Casts at the age of 10 years, 1 month showed that the maxilla had grown some anteroposteriorly and laterally. Two maxillary permanent central incisors were partially erupted, as were the first permanent molars. Very little vertical growth was seen in both maxilla and mandible (Fig. 10, *F*, Case 3). The permanent lower central incisors were partially erupted and filled the space intended for the permanent lateral incisors, since practically no growth had taken place

in the anterior portion of the mandible from 3 years, 6 months to 10 years, 1 month. When the casts were articulated in centric relation, a very marked overbite could be seen, which gave the appearance of an Angle Class II, Divi-

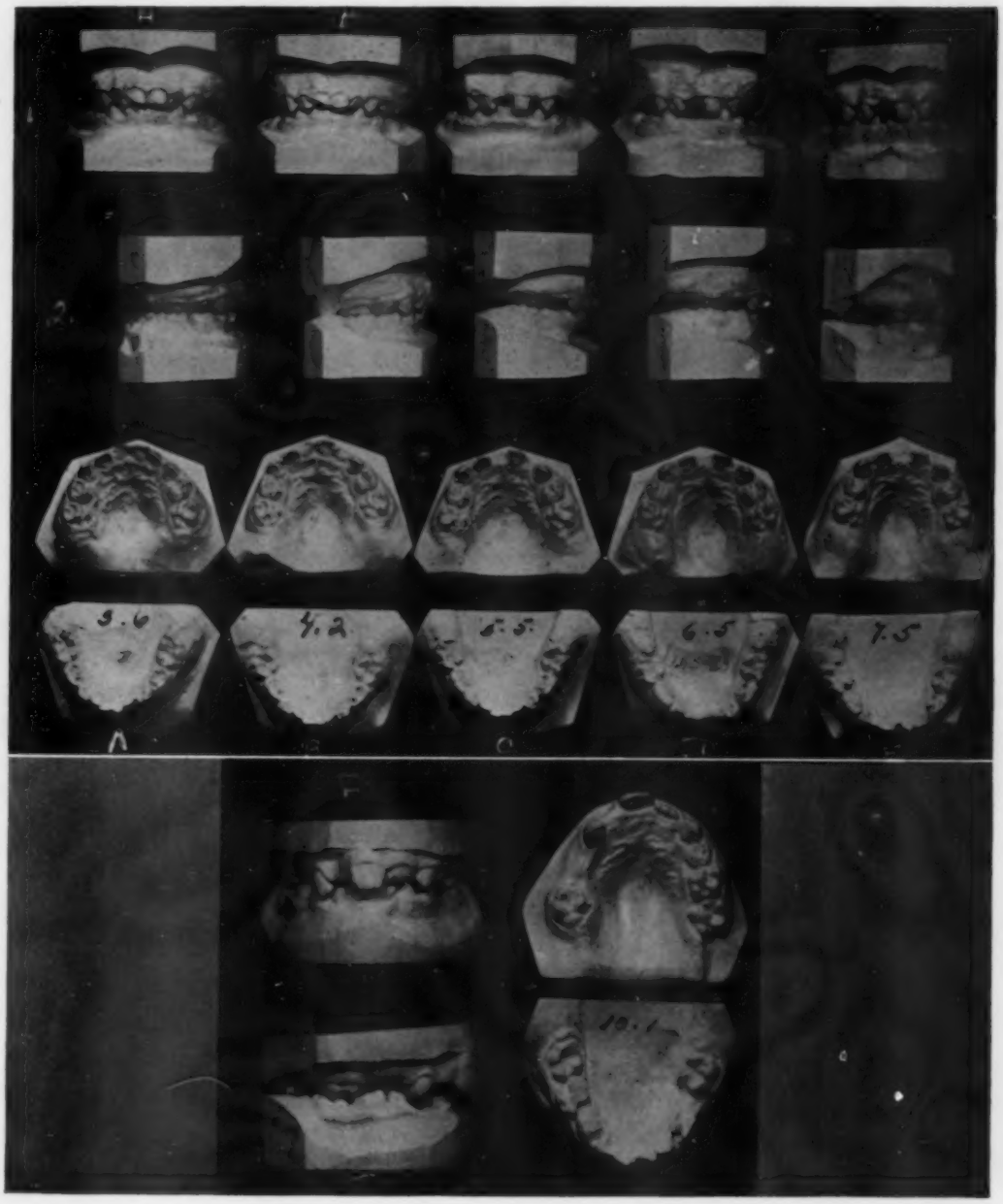

Fig. 10.—Case 3. Maxillary and mandibular casts of W. T. with pituitary dwarfism from 3 years, 6 months to 10 years, 1 month: *A*, 3 years, 6 months; *B*, 4 years, 2 months; *C*, 5 years, 5 months; *D*, 6 years, 5 months; *E*, 7 years, 5 months; and *F*, 10 years, 1 month.

sion 1, malocclusion. Interestingly enough, this child's mother had an Angle Class II, Division 1 malocclusion. This may, genetically, account for the malocclusion seen in this pituitary dwarf.

Lateral views of the casts at the age of 10 years, 1 month (Fig. 10, *F 2*, Case 3) showed a slight increase in intermaxillary space posterior to the first permanent molars. Radiographs at this time showed crowns developing according to the patient's chronological age with the roots retarded in development. There was more retardation of root development in the mandible. The failure of the dental height to increase in this pituitary dwarf can be attributed primarily to an arrest in the ramus length growth.

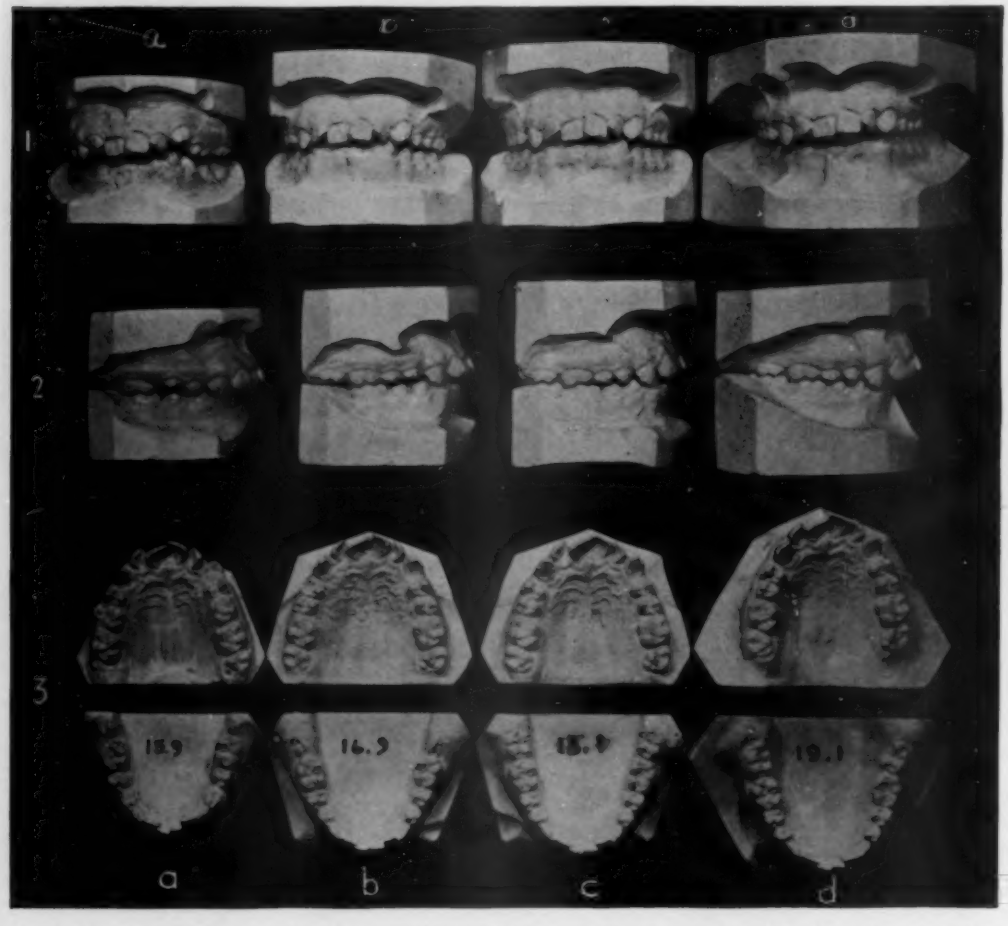

Fig. 11.—Case 4. Maxillary and mandibular casts of L. M. with pituitary dwarfism from the age of 15 years, 9 months to 19 years, 1 month: *A*, 15 years 9 months; *B*, 16 years, 9 months; *C*, 18 years, 1 month; *D*, 19 years, 1 month.

Case 4.—L. M., was a white man, aged 22. In this patient, a diagnosis of pituitary dwarfism was made at the age of 5. In the past medical history, repeated references were made regarding his retarded dental development. At the age of 15 years, 6 months, the patient had the following maxillary teeth: 7-6-v-4-3-2-1-1-2-3-4-v-6-7. These teeth were undererupted and the arch curve was well rounded with crowding of the incisor teeth. The size of the teeth compared favorably with those seen in normal children. Two deciduous molars were seen in the maxilla and a right second maxillary molar had just erupted.

When the casts at 15 years, 9 months were articulated in centric relation, there was a considerable overbite (Fig. 11, *A*, Case 4). This increased as the teeth erupted from the age of 15 years, 9 months, to 19 years, 1 month, as can be seen in Fig. 11, *a*, *b*, *c*, and *d*. The anterior portion of the mandible was underdeveloped, with crowding of the incisors. From 15 years, 9 months to 19 years, 1 month, growth in the mandible distal to the first permanent molar was evident and sufficient space was created for the eruption of the second permanent molar.

This case again illustrates that in pituitary dwarfism with retardation of osseous development, the ramus length growth develops very slowly and is responsible for the lack of intermaxillary space. The vertical dimension of the maxilla and the body of the mandible is decreased and accounts for the undereruption of the teeth at 15 years, 9 months. Lack of growth in the arch form and size in the maxilla and the mandible contributed to the crowding of the incisors.

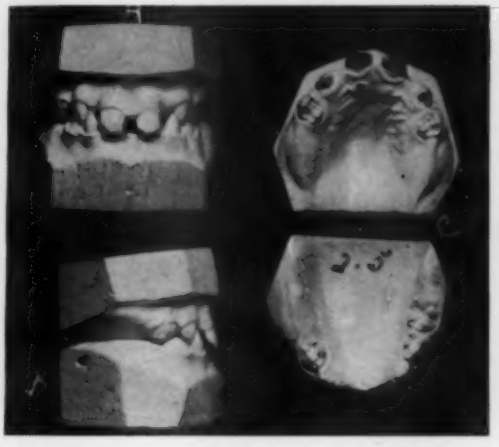

Fig. 12.

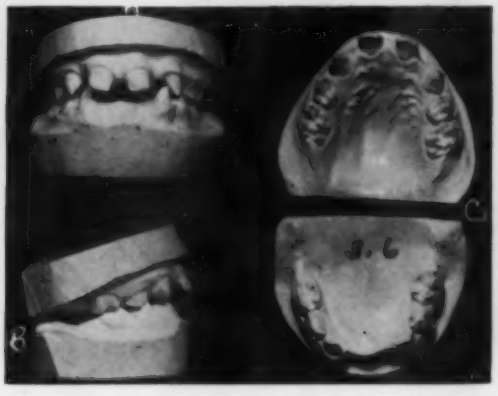

Fig. 13.

Fig. 12.—Case 5. Casts of W. F. with partial anodontia at 2 years, 5 months; *A*, frontal view; *B*, lateral view; *C*, occlusal view.

Fig. 13.—Case 5. Casts of W. F. with partial anodontia at the age of 3 years, 6 months; *A*, frontal view; *B*, lateral view showing intermaxillary space; *C*, occlusal view.

DENTAL HEIGHT OBSERVATIONS ON NORMAL CHILDREN WITH PARTIAL ANODONTIA

Case 5.—W. F., white boy, aged 3 years, 6 months, was first seen at the age of 2 years, 5 months. Oral examination showed the following deciduous teeth erupted in the maxilla and the mandible:

	IV	III	I	I	III	IV	
R							L
	d	e			e	d	e

Roentgenographic survey of the mouth revealed an absence of the right and left deciduous maxillary lateral incisors. The mandible showed an absence of right and left central and lateral incisors. The maxilla and mandible were developed normally, both in width and in depth. When the casts were viewed in centric relation, a marked overbite could be seen (Fig. 12, *A*, Case 5). A

lateral view of the casts, at the age of 2 years, 5 months, showed the gum pads posterior to the last erupted tooth touching each other (Fig. 12, *B*, Case 5). There was no intermaxillary space present. Casts made one years and one month later, at the age of 3 years, 6 months, showed the following deciduous teeth erupted:

	V	IV	III	I	I	III	IV	V	
R									L
	e	d	c			c	d	e	

Fig. 14.—Case 6. Casts of R. M. with anodontia from the age of 9 months to the age of 3 years, 10 months.

When the casts were mounted in centric relation, a marked improvement in the overbite was observed (Fig. 13, *A*, Case 5). A lateral view of the casts showed the deciduous molars in occlusion and an appreciable intermaxillary space between the posterior edentulous gum pads (Fig. 13, *B*, Case 5). Since the mandibular right and left central and lateral incisors were absent, it would be mechanically impossible for any wedging to have occurred in the anterior part of the jaws creating intermaxillary space for the molars to erupt into occlusion. This, again, indicates that in the early years of life it is the downward growth of the temporal bone and the ramus length growth which create the intermaxillary space for the eruption of the deciduous teeth.

Case 6.—R. M., was a boy, white, aged 5 years, 7 months. This child was first seen at the age of 9 months, when clinical examination revealed two erupted mandibular peg-shaped incisors (Fig. 14, *A*, Case 6). No other teeth were seen in the mouth at this time. Roentgenographic examination of the maxilla at the age of 9 months revealed two atypical deciduous central incisors

Fig. 15.—Case 6. Intraoral roentgenograms of R. M. with anodontia at the age of 3 years, 10 months.

and an absence of the deciduous right and left lateral incisors, as well as the right and left deciduous cuspids. All other maxillary teeth were present and developing normally. The mandible showed two peg-shaped incisors with absent right and left deciduous cuspids. Casts at 2 years, 5 months in centric relation showed the following teeth erupted:

V IV I I IV V
R——————————L
e d a a d e

When the casts were articulated in centric relation, there could be seen an overbite, which was within normal limits (Fig. 14, *B*, Case 6). Lateral views of the casts showed the molars in occlusion, and an intermaxillary space was observed in the posterior edentulous gum pads. Casts at 3 years, 10 months, in centric relation, showed an increase in the vertical height of the maxilla with an overbite which was slightly increased (Fig. 14, *C*, Case 6). Roentgenographic survey of the mouth at the age of 3 years, 6 months showed absence of teeth in the maxilla and the mandible (Fig. 15). Lateral views showed the posterior gum pads increased in height due to apposition of bone on the crests of the maxilla and the body of the mandible. At this time, the ramus length growth was retarded. It was not possible for the maxillary and mandibular incisors to wedge the jaws apart, since at 3 years, 10 months, the anterior teeth did not occlude with each other. This case confirms that in the early years of life, it is the downward growth and the temporal bone and the ramus length growth which create the intermaxillary space for the eruption of the deciduous teeth.

DISCUSSION

These observations support the findings of Diamond,[8] Cohen and Wagner,[16] and Brodie and Sarnat,[18] that is, in the absence of diseases of the osseous structures, the jaws and teeth develop independently of each other.

In pituitary dwarfism, where there is a generalized retardation in skeletal development, the ramus length growth is markedly inhibited, resulting in lack of intermaxillary space. There is an arrest of vertical growth of the alveolar processes because of lack of intermaxillary space, while the arch form and size of both jaws are diminished. These factors are responsible for the late eruption of teeth, as well as an alteration in the positional arrangement of the incisors in both jaws. However, the size of teeth in pituitary dwarfism remains normal.

The studies of these cases suggest that the maxilla, mandible, and teeth have their own genetic determinants, a hypothesis which has been proposed by other investigators.[21, 22, 23] This genetic influence seems to be a likely factor in Case 2, which had ectodermal dysplasia with partial anodontia. In this case, the child, who was 8 years, 3 months old, had only 12 teeth, 4 of them in the maxilla and 8 in the mandible. Yet, from the ages of 2 years, 9 months to 7 years, 5 months the mandible showed a progressive prognathism with overerupted, peg-shaped mandibular incisors. The prognathism could be accounted for on a genetic basis, since the child's mother and grandmother had prognathism without evidence of anodontia.[24]

Again, in the case of pituitary dwarfism (Case 3), casts at the age of 10 years, 1 month showed an Angle Class II, Division 1 malocclusion. The malocclusion of the jaws in this case could again be based upon a genetic factor, since this child's mother, too, had an Angle Class II, Division 1 malocclusion. This dwarf's teeth were normal in size; nevertheless, the mandible, which was small, was, in addition, arrested in growth even more markedly than the maxilla. The phenomenon of spatial interrelation may be seen in Cases 2, 5, and 6, in which an intermaxillary space was created for the eruption of the deciduous molars in the early years of life, by a downward growth of the temporal bone together with an increase in the ramus length growth.

It should be noted that these children had an absence of incisor teeth. The jaws, therefore, could not possibly be wedged apart. Nevertheless, sufficient intermaxillary space developed to accommodate the deciduous molars in occlusion. Some intermaxillary space was present between the posterior gum pads. The precise determination of the effect of the downward growth of the temporal bone and the ramus length increase early in life on the development of the intermaxillary space must await further investigation. Cephalometric roentgenographic studies of many very young children will contribute enlightenment and should yield valuable data.

The method which has been found useful for determining the intermaxillary space in this study is extremely simple. It is necessary to include only the edentulous gum pads posterior to the last erupted tooth in the impression. Casts made from such impressions will show the extent of the intermaxillary space when articulated in centric relation.

SUMMARY

1. Additional evidence has been presented that the teeth and jaws develop independently of each other.

2. During the early years of life the downward growth of the temporal bone and the ramus length growth create the intermaxillary space for the eruption of the deciduous teeth.

3. In ectodermal dysplasia with partial or complete anodontia, the intermaxillary space develops normally since there is no retardation in skeletal development.

4. When there is a general retardation in skeletal development, as seen in pituitary dwarfism, the ramus length growth is markedly impaired and the intermaxillary space fails to increase. This contributes to the late eruption of teeth and decreases the vertical dimension of the maxilla and the size of the body of the mandible.

5. When anodontia occurs in the anterior part of the mouth in young normal children, it is mechanically impossible for the teeth to wedge the jaws apart. This proves that the intermaxillary space which develops is to be attributed to the downward growth of the temporal bone and some ramus length growth.

6. The findings in Case 2 (ectodermal dysplasia) and Case 3 (pituitary dwarfism) indicate that there are specific genetic determinants for the teeth, the maxilla, and the mandible.

These observations suggest that the development of the intermaxillary space is predetermined by hereditary factors. In the absence of disease or trauma, normal development can be anticipated.

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A Survey of Antero-Posterior Abnormalities of the Jaws in Children Between the Ages of Two and Five and a Half Years of Age: By Professor H. F. Humphreys, J. B., Ch.B., F.D.S., R.C.S. Eng., and B. C. Leighton, H.D.D. Glas., L.D.S. Eng. From the School of Dental Surgery, The University of Birmingham. *Brit. D. J.* **88**: 3-15, Jan. 6, 1950.

This is believed to be the first statistical enquiry into the etiology of postnormal occlusion carried out on preschool children on a sufficiently large scale to give reliable results.

The material has been obtained from the Maternity and Child Welfare Clinics of the City of Birmingham, a Maternity and Child Welfare Service organized separately from the School Medical Service. The welfare centers are distributed in all parts of the city and are attended by a good cross-section of the middle and poorer classes.

Three thousand, three hundred eighty children were inspected. After consultation with the Medical Statistics Department of Birmingham University, it was decided to investigate in greater detail 1,000 cases, half of which were to be postnormal. (Distoclusion—J.A.S.) This number is statistically adequate to give a high coefficient of probability, and an increase in the numbers analyzed would not raise this coefficient *pro rata*. Five hundred cases showing postnormal occlusion were investigated together with another 500 cases with normal occlusion, and 33 cases showing prenormal occlusion were added for comparison. When an initial pilot survey of a few hundred children had been carried out it was decided to reject those under 2 years of age as the diagnosis of anteroposteroir deviations was so frequently open to doubt.

Reference to previous literature on the subject of normal occlusion of the teeth in children under 6 years shows that the position of the mandible relative to the maxilla is not constant. The mandible moves forward in relation to the maxilla throughout the years of early development but there seems to be no fixed rule for the rate of this forward translation. This research is statistical and the diagnosis of anteroposterior deviations of the jaws relative to each other forms its basis.

The canines have been used as the guide to occlusion because the second deciduous molars of some of the younger children were not erupted, but the occlusion of the second deciduous molars was recorded when present. When the tip of the upper canine was vertically above or in the same coronal plane as the distal surface of the lower canine, the case was considered the ideal normal. As regards the second deciduous molar the occlusion was considered ideally normal when the tip of the mesiobuccal cusps of the upper molar fitted into the mesiobuccal groove of the lower molar. Unless the relationship of the canines or second molars had deviated from the above normal by at least one half unit, that is, half the anteroposterior width of the canine, or half the anteroposterior width of molar cusp, the occlusion was considered normal. If the malrelationship of the canines was one half unit or more, then the case was classified as being postnormal or prenormal, depending on the direction of deviation.

The information obtained fell into eight categories:

(a) *Personal Details of Child.*—Intake of vitamins A, C, and D was noted and a possible deficiency was recorded when the ration of orange juice and cod liver oil or other substitutes had not been taken for at least six months. The appetite of each child was recorded, together with a general impression of its health and details of any illness. This information, together with records of age, weight, and height gave a general picture of tendencies to ill health or malnutrition.

(b) *Personal Details of Mother.*—The history of the mother is recorded to disclose any condition which might affect the child, especially before birth and while being fed at the breast. The age at the time of birth of the child, previous births, stillbirths, and miscarriages, together with details of health during pregnancy and after the birth, are recorded. The pregnancy was divided into three three-monthly periods to show the stage at which an illness occurred.

(c) *Birth of Child.*—It has often been suggested that the effect of moulding during labor may affect the ultimate form of the face, particularly if the presentation of the infant be abnormal. There is a great temptation to believe that flexion of the head, by causing pressure on the mandible, may lead to a post-normal position of the lower jaw.

(d) *History Before Weaning.*—Many dental abnormalities have been attributed to bottle feeding as opposed to breast feeding, largely because of its mechanical effect and not because of the altered quality of the milk. They included one question on the duration of breast feeding and one on the nature of food given artificially, either as a supplement to breast feeding or to replace it entirely.

(e) *Upper Respiratory Tract.*—Abnormal conditions of the nose causing nasal obstruction are widely believed to be associated with defects of the dental arches, particularly with a narrow upper arch, and often with post-normal occlusion. The latter is often said to be "secondary" to the narrow upper arch. It was hoped to examine the nasopharynx of each child, the condition of the nasal septum, the nasopharyngeal tonsils and the palatine tonsils. This was not carried out in full because the difficulties involved with children so young were found to outweigh the advantages of the thorough examination, and because hypertrophy of adenoid tissue would probably cause other symptoms, e.g., loss of appetite, frequent colds, coughs, and perhaps nasal obstruction. The palatine tonsils were examined by the same operator in each child because it was felt that there would be less error than if several specialists examined the children. The development of the alae nasi, the presence of mouth breathing, and whether there was a tendency for the mouth to remain open were all noted, as well as the amount of fresh air the child received each day. If the child had been out in the fresh air whenever there was no rain, then it was recorded that the atmosphere in daytime was "fresh air." Mouth breathing was tested by applying the tongue depressor horizontally to the upper lip under the nose and then holding a wisp of down in front of the mouth, below the depressor. Condensation of vapor on the depressor was noted also as a check.

(f) *Habits.*—Habits, particularly those involving sucking movements, have long been associated with proclination of the upper incisors, even more so by the lay public than by the profession. There is no doubt that they affect the incisors, but there was some doubt as to whether they may effect the relative position of the jaws. After the pilot survey, it was obvious that they play quite an important part. It was therefore decided to divide all sucking habits into those operating with an anteroposterior force on the incisors, and those operating with a vertical force. Because the children were so young it was possible to study these habits in operation.

(g) *Dental Examination.*—The occlusion of the deciduous canines and second molars was recorded. The overbite and overjet were measured with dividers and a millimeter scale to the nearest millimeter. They were measured at the mesial border of the incisal edge of the upper central incisors. There were a few cases when the measurements differed on each side of the mouth and in these the greater measurement was taken. The overjet was estimated with the mandible in its usual position of occlusion.

Spacing of the teeth was estimated by means of a steel mixing spatula. If the spatula could be passed freely between the teeth, then a space was deemed to be present; but if it would not pass or became wedged, then no space was accounted. Only if the space was bilateral was it counted.

Details of abnormalities of the jaws other than anteroposterior abnormalities included only cross-bite and narrow arches. These were estimated visually, a narrow arch being considered as such only when excessively narrow.

The tone of the lips was assessed visually. In cases of doubt the forefinger was placed between the lips, and the child encouraged to tighten the lips to prevent its entrance into the mouth. The presence of gingivitis was diagnosed by the color of the mucous membrane and the amount of swelling present. The age of eruption of the first tooth was obtained from the mother, and checked with the records when possible.

(h) *Details of Examination of Family.*—The standards of abnormality for members of each family were the same as for the children. Where the canines and the first molars were lost or when there was any doubt, then the diagnosis was considered as unknown. The age and sex of the brothers and sisters were noted.

Of the 2,711 children on whom a diagnosis was made, 681 were postnormal (25.12 per cent), and 42, prenormal (1.52 per cent). A tentative diagnosis was made on the 669 rejected cases, of which 318 were boys and 351 were girls. 25.79 per cent of the boys, and 17.26 per cent of the girls were postnormal; and 3.14 per cent of the boys and 3.13 per cent of the girls were prenormal.

The 2,711 children on whom a diagnosis was made were divided into boys, of whom there were 1,346, and girls, of whom there were 1,365. Of the boys 364 (27.04 per cent) were postnormal, and 22 (1.63 per cent), prenormal. Of the girls 317 (23.22 per cent) were postnormal, and 20 (1.47 per cent), prenormal.

Postnormality is then 3.82 per cent more frequent in boys than in girls. The standard deviation of this difference is 1.666, and the difference is 2.3 times greater than this figure. This is a significant result.

This incidence of postnormality may seem to be high, because the criteria of abnormality used for this survey are not the same as those often used in practice. Many orthodontists consider as postnormal those cases when the cusp relationship deviates by more than half a unit, because in those cases the inclined plane of the cusps will tend to emphasize the abnormality. A deviation of only half a unit, or cusp-to-cusp relationship, will be unlikely to deteriorate.

There is a slight increase in the incidence of postnormality as age increases, whereas prenormality decreases. This result was unexpected, particularly in view of the changes that are said to take place with age in the relationship of the jaws. It is unlikely that the incidence of postnormality decreases with age.

The total incidence of postnormality in the poorer homes is slightly greater (1.49 per cent) than in the better-class homes. The most striking difference (30.9 per cent as compared with 21 per cent) appears in children of 2 to 2½ years, but owing to the small number of cases involved it cannot be considered as important.

Postnormality as defined for this research was found in about 25 per cent of children of preschool age, and was significantly more prevalent in boys than in girls. Prenormality was present in about 1.5 per cent of children, and was seen also slightly more frequently in boys than in girls. There is a very slight tendency for postnormality to increase as age advances, and for prenormality to decrease.

The replies of the mothers to questions on the health of the child since weaning indicate that the postnormal children appear to their mothers slightly less healthy than normal children or than the prenormal child. The difference is not greater than could be accounted for by chance. When the incidence of the various illnesses that occurred during this time was examined, it was found that there was very little difference between the three groups of children.

The appetite of the postnormal group was found to be slightly poorer but again it could not be claimed as being beyond the possibility of a chance variation. Although postnormal children took orange juice, or a substitute, slightly more frequently than the normal children, there was no difference in the amount of vitamin D preparation taken. It appears unlikely that vitamin deficiency is an important factor if cod liver oil and other preparations are considered as adequate substitutes for vitamin D from milk, butter, eggs, and fish.

Tables were constructed to show the correlations between the incidence of normal and postnormal occlusion on the one hand and the average height and weight of the children on the other, since the latter gave an indication of general health. The postnormal children were consistently lighter (a pound or slightly less) than normal children of the same age. They were also a little shorter (less than one inch) in most age groups but the difference was not so constant as that of the weight. These differences were too marked to be due to chance. The increases in height and weight did not occur at a uniform rate during this growth period but showed stages of retardation most marked from 3 to 3½ and from 4½ to 5 years, and these stages were more marked in the postnormal children, though present in both groups.

Postnormal children eat their food a little more rapidly than normal children, but the difference is small. The hardness of the food of the postnormal group was significantly greater than in the normal group: this was not expected and is difficult to explain. It certainly indicates that the exercise used in chewing hard food such as crusts has little effect on the relationship of the jaws to each other. To assess the hardness of the food, each mother was asked whether the child has some hard food such as a crust or toast to eat three times or more a day.

The general impression given by the results is that the postnormal group appears slightly weaker physically than the normal group, although their resistance to illness is not impaired in any way. There is no reason to suspect that the age of the mother at the time of the birth of the child has any bearing on our problem.

There was found to be no difference in the number of miscarriages and stillbirths that preceded each of the three groups of children. It was found also that 52.0 per cent of the normal children, 47.8 per cent of the postnormal children, and 45.5 per cent of the prenormal children were first pregnancies, i.e., not preceded by any births, stillbirths, or miscarriages. This is the reverse of what might have been expected although the difference is not too great to be accounted for by chance.

The number of cases of serious ailments for which a doctor ordered rest in bed or hospital treatment is enumerated. In these cases the result in the first and third trimester is the reverse of that shown in the previous table.

These differences are statistically significant and the only explanations the authors can put forward are that either the postnormal children had mothers who, in many cases, failed to seek or to accept treatment for these conditions, or that the rest prescribed by the doctor was beneficial to the welfare of the child and reduced the incidence of postnormality. Most of these patients rested in bed or hospital as a precautionary measure because there was a possibility of toxemia.

If the instrumental births and births induced artificially are added to the normal births, then the figures are uniform. An interesting point is the total absence of abnormal presentations of prenormal children, although the number of cases is small. Another fact worthy of note is that more normal children were born by Caesarian section than postnormal children, and if more cases had been available, this tendency might have suggested that when there is no moulding of the head by pressure during delivery a normal relationship of the arches is more likely to develop.

There is no evidence that abnormalities of labor cause postnormality of the mandible or that abnormal presentations have any bearing on the problem.

The postnormal groups were weaned slightly earlier than the normal group, the average weaning age in months for normal, postnormal, and prenormal groups being 10.8 and 11.7 months, respectively. The postnormals were fed by bottle more frequently but the difference was not significant. The type of food given by bottle varied little between the groups. The health of the mothers of normal children was slightly better than that of the postnormal children. It was found that the health of mothers who breast fed their children for more than twenty weeks was poorer in the postnormal group. In spite of this, the health of the children of these mothers was equally good in both the normal and postnormal groups, and was better than that of the mother.

The mouths of postnormal children were left open both night and day more frequently than those of normal children though more of the latter leave their mouths open during *either* the day *or* the night. In spite of this fact, postnormal children do not mouth breathe appreciably more. Only 6 children out of 1,033 were found to be breathing solely through the mouth. In nearly half of those cases when the mouth was left open, breathing was taking place *only* through the nose. In those cases when there was snoring there can be little doubt that the mouth was being used for breathing at night, but in those cases when there was no snoring it is possible that the mouth was not used for breathing even at night.

More children of the postnormal than of the normal group were allowed fresh air only occasionally and the difference is significant. This is interesting because of the views of Dr. J. Sim Wallace who maintains that a warm atmosphere at night and fresh air by day are beneficial.

It was found that the palatine tonsils were not enlarged more frequently in the postnormal than in the normal group. On the other hand it is significant that enlargement of the superficial cervical gland behind the ramus of the mandible was present more frequently in the postnormals. This suggests a correlation between postnormality and infection of the throat, and not between postnormality and the size of the tonsils.

The general picture then of a postnormal child is of one with a tendency to poorly developed alae nasi, to keep the mouth open, although they do not tend to mouth breathe more frequently than the average child, and to infection of the throat and tonsils without more tonsillar enlargement than the average. All this may arise from the lack of fresh air that the child received compared with the normal child.

More postnormal children used dummies (pacifiers) than did normal children, and when the duration of the habit is examined, it is seen that the postnormal children persisted with it much longer.

About half of the mothers whose children had used dummies were asked whether the disc of the dummy was hard or made of rubber. Their replies were tabulated, and it was found that there was no reason to suspect that this affected the relationship of the jaws.

The correlation between sucking habits with an anteroposterior force and postnormality is very marked. Twice as many postnormal children sucked their digits with an anteroposterior force as did normal children, and there can be no doubt of this correlation. When the duration of the habit was examined it was found that it was longest in the postnormal group.

As regards sucking habits with a vertical force, the position is reversed, although the differences are less significant.

Habitual use of the teething ring was commoner in the normal group. The type of swallowing, as mentioned earlier, was difficult to assess in these very young children. The figures obtained did suggest that an infantile type of swallow is more commonly seen in postnormality, but it may possibly be a result rather than a cause.

Fewer children of the postnormal group (28.8 per cent) slept on the back than normal children (34.6 per cent), and more of them slept crouched on all fours (9 per cent and 5.4 per cent), their knees drawn up under the stomach. These differences are only just significant ($p = 1$ in 26). The numbers of children who slept in other positions were very similar in each group.

There is a correlation between the hand on which sucking takes place and the side of the mouth affected in unilaterally postnormal cases. Of those patients with postnormality on the right side only, about whom information was available, twice as many sucked the right hand as the left; but of those patients when the left side was affected, equal proportions sucked the right and left hands. Comparison with the normal children shows that postnormality results much more frequently from those cases when the right hand is used, the difference being 3.52 times the standard deviation. This is not unexpected, as the right hand, being usually the stronger, would be more active in causing a deformity than the left.

Although many normal children have sucking habits, there is a strong correlation between a vertical force on the incisors and normal occlusion, and between an anteroposterior force and postnormal occlusion. But the number of children who sucked with an anteroposterior force on the incisors and still had normal occlusion suggests that another factor is involved, the resistance of the jaw to displacement which varies from one child to another. It is possible that the position of the mandible in relation to the maxilla determines the direction of the force applied to the incisors and that the sucking habit merely emphasizes a condition that was already present at birth. For it is obviously easier to apply anteroposterior force if there be some pre-existing postnormality. If this be the case, then the sucking habit may easily turn the scales against the recovery of a very slight postnormality.

ORAL EXAMINATION

Both of the upper deciduous second molars had erupted in 455 normal and 439 postnormal cases: both of the lower deciduous second molars had erupted in 436 each of the normal and postnormal cases.

As would be expected, the postnormal group showed a greater variability of overbite of the incisors and the number of cases where the bite was open anteriorly was much greater (11.6 per cent to 4.6 per cent in the normals). A

similar disproportion was revealed in the number of cases where there was an overbite of more than 3 mm. (53.6 per cent postnormal and 33.6 per cent normal). The open-bite cases were almost all associated with sucking habits, usually dummies. In fact an open-bite at this age may be said to be pathognomonic of a sucking habit.

The overjet of the incisors was very significantly greater in the postnormal group: there were 73.8 per cent of the postnormals and 15.0 per cent of the normals with an overjet of more than 3 mm.

The spacing of the teeth was greater in the normal group of which only 8.6 per cent had no spaces at all in the upper jaw and 15.8 per cent no spaces in the lower jaw. The corresponding figures for postnormals were 20.68 and 29 per cent. When the children were divided into age groups it was found that the spaces between the molars tended to close at about 3 to 4 years in both, and those in the incisor region increased as age advanced.

There was a definite tendency for the postnormal and prenormal groups to contain more cases of a narrow upper arch than the normals. If cases of cross-bite may be considered as being a sign thereof, then 2 per cent of the normal and 7 per cent of the postnormal group had a narrow upper arch; this difference is very significant ($p = 1$ in 1,000).

As regards the association of gingivitis with the resting position of the lips, it was found that there were significantly more cases in the postnormal group, when the lips were apart.

The lip tone of the normal group was significantly better, 29.8 per cent of the normals and 20.6 per cent of the postnormals having good lip tone.

The age at which the first deciduous tooth erupted is similar in the two groups of children.

The postnormal cases then had a tendency to deviate from the normal overlap, to have an excessive overjet of the incisors and a narrow upper jaw. The poor lip tone and tendency for the lips to be parted, together with the possibility that the swallowing reflex is abnormal, suggest that poor muscle tone and lack of correct function contribute to deterioration in the proper relationship of the jaws.

There is a difference between the incidence of postnormality in parents and siblings of normal children and in those of postnormal children. This difference is not significant in the fathers ($t = 1.86$, $p = 1$ in 16) but is suggestive. Had it been possible to obtain more data about them and had the difference (percentage) remained the same, then it would have been significant. In the mothers this difference is significant ($t = 2.80$, $p = 1$ in 200) partly because it is a greater difference and partly because there were more cases. For similar reasons the difference in the siblings is even more significant ($t = 6.20$).

Earlier loss of teeth occurred in mothers of postnormal children than in mothers of normal children. This could be explained by the fact that the incidence of postnormality is greater in the parents of postnormal children, and when there is postnormality the teeth are more likely to be lost prematurely, particularly in women, for esthetic reasons.

The association of postnormality is then strongest between the children and their siblings, less strong between them and their mothers, and still less so between them and their fathers. No genetic explanation of this can be put forward and it is suggested that it is caused by environmental factors. It would be expected that any defects of nurture that contribute to produce postnormality would operate equally in the case of siblings as in the children them-

selves because they are brought up by the same mother. In addition to this, children very frequently ape mannerisms and habits of expression or speech from those around them, particularly from older children, and to a less extent from their mothers. Further, there is a possibility that among the family traditions for bringing up children that are passed from mother to daughter, but not to sons, may be some that are factors in producing postnormality. These three possibilities would all emphasize an association of postnormality between brothers and sisters and to a less extent between children and their mothers, but would not affect an association between children and their fathers.

The authors put forward a hypothesis to account for the unexpectedly high incidence of postnormality in the mothers which is incapable of proof but may have some validity, and is not entirely original. Mild degrees of postnormality are often characterized by a slight prominence of the upper incisors which gives the appearance of a smile. This expression provokes an answering smile with the result that the postnormal subject sees smiles in others and the world appears to him or her a happier place than it does to most people. A happy environment cannot but influence the temperament of the subject, particularly when young, and this suggests that postnormal subjects tend to have a happier disposition than others.

During the collection of data for this survey the authors were impressed by the amount of deformity that sucking habits, particularly of the thumb, cause to the jaws. In most cases the habits start at birth, or soon after, and the majority have a strong desire to suck at any convenient object. If some sort of comforter is not provided then resort is made to the fingers or thumb and nurses often withhold the dummy and substitute the thumb because it is believed that this is the lesser evil. A few patients were found to have acquired the habit at the time of teething or of weaning.

More mothers of affected children had poor health at the time of suckling the child and the significance of this is definite ($t = 2.3$). Fewer children with the habit were breast fed for more than twenty weeks, and significantly less of them were breast fed for more than forty weeks ($t = 3.1$). More of the affected children were bottle fed and it seems likely that the reason for the increased use of the bottle was the poorer health of the mother. It is very common to find that a change is made from breast feeding to bottle feeding because the breast milk is of an inadequate standard, possibly due to deterioration in the mother's health. If the breast milk is of poor quality the infant may quite easily be hungry for some time before the change is made. It is suggested that at least some sucking habits may be started during a period of undernourishment when the child sucks his fingers to satisfy his hunger or is given a comforter to quiet him, especially at night. The hunger may be undetected for some time and the signs of it may be masked by the comforter.

No difference was found between the health of the two groups of children at the time of suckling, and it would therefore seem that any malnutrition is so mild as to cause no symptoms. The appetite of the children with sucking habits was found not to be depressed, and no association was found with enlargement or infection of the tonsils, but the children did have signs of a narrow upper arch more frequently than others, as would be expected. The overjet of the incisors is very much greater and there is either excessive overbite or an open-bite; the lip tone is not affected to any appreciable extent.

Hunger at the time of sucking is then a factor that might play a part in causing these habits. It is probable that there are others, e.g., the suggestion put forward by Salzmann that thumb sucking might in some cases commence in utero.

SUMMARY OF REPORT ON A STATISTICAL ANALYSIS OF POSTNORMALITY AND ITS ASSOCIATION WITH CERTAIN FACTORS, CARRIED OUT ON PRESCHOOL CHILDREN (BY THE AUTHORS)

Equal numbers (500 of each) of children with postnormal and normal occlusion were taken for statistical analysis. It was found that the incidence of postnormality was greater in boys than in girls, being 27.0 per cent in boys and 23.2 per cent in girls. It showed no tendency to decrease between the ages of 2 and 5 years.

Postnormal children are very slightly weaker physically than normal children, but their resistance to illness is as good. The general health of the mothers during pregnancy is as good in the postnormal as in the normal group. There is no reason to suspect that there are any factors in the delivery of the child that might cause postnormality.

Neither the age of completion of weaning, the method of feeding, nor the type of food given before weaning caused any appreciable difference between the two groups. There is no clear evidence that bottle fed babies show greater postnormal tendencies than those fed at the breast.

Infection of the throat, poor lip tone, open-mouth, and poorly developed alae nasi are all characteristics seen more frequently in postnormal children, but enlarged tonsils were not predominant in this group, as has been suggested by some authorities. More postnormal children were "in fresh air infrequently" and had their mouths open at rest, but there was no difference between the groups in the method of breathing. It was found that only 6 out of 1,033 children breathed exclusively through the mouth.

Sucking habits are very strongly associated with postnormality, particularly when the force exerted is in an anteroposterior direction, that is, when the digit is inserted vertically. Although these habits seem very potent there were some children whose jaws showed considerable resistance to an anteroposterior force and remained normal. It would seem then that the effect of these habits depends on the direction of force, the duration and intensity of the habit, and the resistance of the jaws to displacement. Dummies were found to be harmful but not so damaging as thumb sucking.

There is a very strong familial trend in postnormality, most marked between the affected children and their siblings, less strong with their mothers, and weakest with the fathers; but the number of fathers seen was too small for this to be firmly established. An explanation of this diminishing association of postnormality is put forward.

It can be seen from this summary that sucking habits form the only major factor at which any preventive measures can be aimed. It was therefore decided to investigate them further and search for factors likely to cause them.

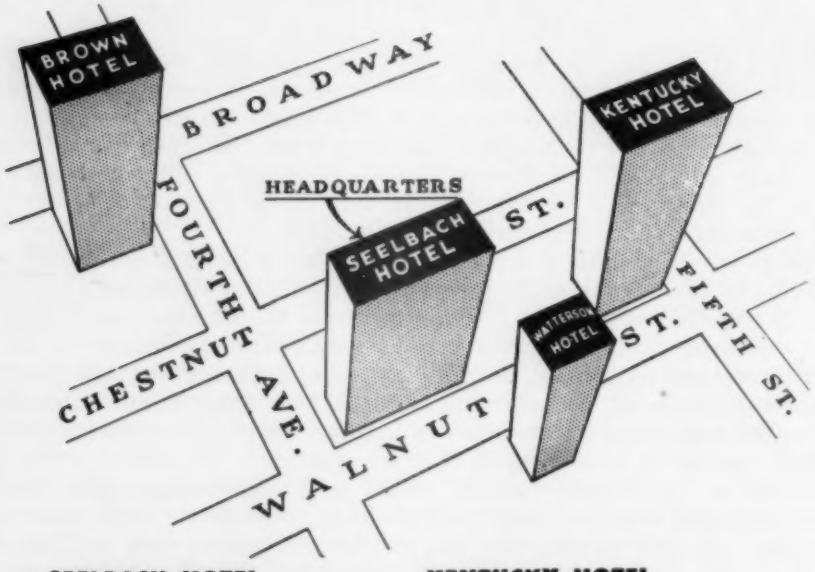
Some evidence was found that mothers of children with sucking habits had poorer health during the sucking period, and it is suggested that these habits may be induced in many cases by a mild subclinical hunger.

News and Notes

American Board of Orthodontics

The 1951 meeting of the American Board of Orthodontics will be held at the Seelbach Hotel in Louisville, Ky., April 18 through April 22, 1951. Orthodontists who desire to be certified by the Board may obtain application blanks from the Secretary, Dr. C. Edward Martinek, 661 Fisher Bldg., Detroit 2, Mich. Applications must be received not later than March 1, 1951, for consideration at the Louisville meeting.

Meeting of the American Association of Orthodontists, Louisville, Ky., April 23-26, 1951



SEELBACH HOTEL
Single: $4.00, $5.00, $6.00, $6.50, $7.00
air-conditioned rooms start at $5.00
Double: $7.00 to $11.00
Twin: $7.00, $8.00, $9.00, $10.00, $11.00
air-conditioned rooms start at $8.00
Suite: $18.00 (six only)

WATTERSON HOTEL
Single: $3.25, $3.50, $4.00, $4.50
Double: $5.50, $6.00, $6.50, $7.00
Twin: $6.50, $7.00, $8.00
Suite: $8.00, $10.00, $12.00
air-conditioned rooms $1.00 extra

KENTUCKY HOTEL
Single: $3.50 to $6.00
Double: $5.50 to $10.00
Twin: $7.00 up
Suite: $14.00 to $18.00
Room for three people: $9.00
air-conditioned rooms $1.00 per day extra

BROWN HOTEL
To secure rates and reservations at the Brown Hotel communicate direct with hotel

The above picture shows the location of the hotels. Louisville is centrally located—so are the hotels. Reservation cards will be sent to the members. Reservations should not be sent directly to the hotels, but to Dr. John A. Atkinson, 896 Starks Bldg., Louisville 2, Ky.

Prize Essay Contest, American Association of Orthodontists

Eligibility.—Any member of the American Association of Orthodontists; any person affiliated with a recognized institution in the field of dentistry as a teacher, researcher, undergraduate or graduate student shall be eligible to enter the competition.

Character of Essay.—Each essay submitted must represent an original investigation and contain some new significant material of value to the art or science of orthodontics.

Prize.—A cash prize of $500 is offered for the essay judged to be the winner. The committee, however, reserves the right to omit the award if in its judgment none of the entries is considered to be worthy. Honorable mention will be awarded to those authors taking second and third places. The first three papers will become the property of the American Association of Orthodontists and will be published. All other essays will be returned.

Specifications.—All essays must be typewritten on 8½ by 11 inch white paper, double-spaced with 1 inch margins, and composed in good English. Three copies of each paper, complete with illustrations, bibliography, tables, and charts must be submitted. The name and address of the author must not appear in the essay. For purposes of identification, the author's name, together with a brief biographical sketch which sets forth his or her dental and/or orthodontic training, present activity and status (practitioner, teacher, student, research worker, etc.), should be typed on a separate sheet of paper and enclosed in a sealed envelope. The envelope should carry the title of the essay.

Presentation.—The author of the winning essay will be invited to present it at the meeting of the American Association of Orthodontists to be held at Louisville, Ky., April 23-26, 1951.

Final Submission Date.—No essay will be considered for this competition unless received in triplicate by the Chairman of the Research Committee on or before March 1, 1951.

WENDELL L. WYLIE, Chairman, Research Committee,
American Association of Orthodontists,
University of California Medical Center,
San Francisco 22, Calif.

Northeastern Society of Orthodontists

Excerpts from the program given before the Northeastern Society of Orthodontists Nov. 6 and 7, 1950, at the Shoreham Hotel, Washington, D. C., under the direction of Dr. Richard Lowy, President, follow:

Community Orthodontic Service. Augustus L. Wright, D.D.S., Philadelphia, Pa.
Assisted by Samuel Gilbert, D.D.S.
John Flanagan, D.D.S.
Albert Weiser, D.D.S.
Warren Bieler, D.D.S.

The operation of a low fee orthodontic service clinic. (1) Historical background and formation of the clinic. (2) Professional personnel. (3) Patients. (4) Treatment. (5) Conclusion.

Habits in Action. Kyrle W. Preis, D.D.S., Baltimore, Md.

Motion picture, a study in motion of the various habits both intraoral and extraoral which affect the development of the facial and oral structures that may profoundly affect dental occlusion.

Cooperation between the Orthodontist and Oral Surgeon in the Diagnosis and Care of Impacted Teeth. Sterling V. Mead, D.D.S., Washington, D. C.

Luncheon, Terrace Banquet Room Report on the A.D.A. Meeting. Daniel F. Lynch, D.D.S., Washington, D. C.

The Split Tube and Lock and the Swirl Tube Attachments. Alexander Sved, D.D.S., New York, N. Y.

These attachments are used in combination with the edgewise and the modified edgewise arch appliances for the alignment of the anterior teeth. The arch wire is fastened by a special lock in the split tube. In the swirl tube, the arch wire is self-locking.

The Importance of Orthodontic Fundamentals. Leigh C. Fairbank, D.D.S., Washington, D. C.

This paper will deal with important considerations in case analysis and the imperative need for their consideration in treatment planning. If one is to be assured of functional efficiency, stable results, and improved esthetics following orthodontic treatment, these three objectives cannot be assured without careful study, correct planning, and efficient treatment.

CLINICS

Management of Buccal Segments; nonextraction and extraction cases. Lt. Col. William H. Day, D.D.S.

Construction of Welded Molar Bands. William G. Houghton, D.D.S.

Practical Points of Value From "The Orthodontic Melting Pot." Aubrey P. Sager, D.D.S.

The Key Ridge Indicator. Saul M. Bien.

Photographic Reproductions With Simple Camera Set-ups. Ulysses Frederich.

Application of Russell Molar Lock. S. J. Hecht.

The Appraisal of Malocclusion in Deciduous and Mixed Dentitions. S. T. Kohn.

The Alignment of Buccal Tubes With Aid of Spot Welder. M. J. Maxian.

Classification of Canines and Their Distal Relocation. E. R. Strayer.

The Role of Diagnostic Set-ups in Orthodontic Planning. A. L. Ungar.

Adjuncts for Stabilization. L. E. Yerkes.

D. Robert Swinehart, D.D.S.
C. Weber Volckmer, Jr., D.D.S.
Leon H. Wayman, D.D.S.
DeForest Whitmarsh, D.D.S.
Carl Zeisse, D.D.S.

Treatment Procedures of Simple Form Which Have Proved Their Worth. George M. Anderson, D.D.S., Baltimore, Md.

(1) Appliance for moving lingually erupted maxillary incisors to normal position. (2) Mandibular removable retainer with incisor spring. (3) Soldered spring to lingual arch.

The Structure and Properties of Tooth Surfaces, as Studied by Optical and Electron Microscopy. David B. Scott, D.D.S., M.S., Bethesda, Md.

The newly developed replica techniques have provided much information about the basic structure of tooth surfaces, the changes occurring in initial caries, and the effects of certain chemical agents. Special emphasis will be placed upon tooth surfaces in young individuals, and the effects of cements and fluorides.

Diseases and Tumors of the Mouth of Interest to the Orthodontist. Colonel Joseph L. Bernier, D.D.S., M.S., F.R.C.S.

A number of benign and malignant reactions affect the maxilla and mandible and their adjacent structures in a manner often precluding clear clinical manifestations.

Applied Biometrics in Rational Therapy. Milton R. Culbert, D.D.S., Toronto, Canada.

Luncheon, Terrace Banquet Room, honoring Joseph D. Eby, President of the American Board of Orthodontics.

Dental Research at the National Institutes of Health. H. Trendley Dean, Bethesda, Md.

Central Section of the Pacific Coast Society of Orthodontists

The last quarterly meeting was held at the Alexander Hamilton Hotel, Tuesday, Sept. 12, 1950.

Members present were: Ray A. Lussier, Bernard Matzen, Arthur J. Corbett, Leland E. Carter, Allen E. Scott, Reuben L. Blake, Carl Engstrom, George B. Lemon, Harry S. Thompson, Ray Brownell, J. Kester Diment, Ernest L. Johnson, Fred Epley, James R. Seaman, Roy C. Cowden, Fred T. West, Murray Ballard, Arthur Skaife, Howard H. Jan.

Guests present were: Lloyd M. Cox, George Merchant, Peter J. Ceremello, H. S. Albarian, P. Picard, Tom Reeves, Eugene E. West, Bill Ballard, John E. Dumon, T. N. Engdahl, Jr., A. Cass, N. H. Anderson.

The afternoon meeting was devoted to the showing of a film made by Dr. Brusse, entitled "Management of Stainless Steel and Electric Soldering and Fabricating Crozat Appliances."

The evening session was called to order by Chairman Ray Lussier at 8:20 P.M.

Chairman Lussier asked the assembled group to stand in silent reverence to the memory of our late departed member, Jack Loughridge, of Sacramento.

Secretary Cowden read a letter from Dean Fleming of the University of California thanking the Central Section on behalf of the Regents of the University for the recent gift of $25 in memory of our late departed member, Will Sheffer, of San Jose.

Applications for membership in the A.A.O. and Central Section of P.C.S.P. were read for the following five men: Peter J. Ceremello, Oakland; W. Robert Campbell, Stockton; Lloyd Malcolm Cox, Santa Rosa; Theodore N. Engdahl, San Jose; Frederick William Heitman, Jr., Merced.

These applications will be processed through the regular channels.

Program Chairman Charles A. Konigsberg then introduced the speaker of the evening, who was Douglas Gordon Campbell, M.D., Assistant Clinical Professor of Psychiatry, University of California; Consultant in Psychiatrics to the Veterans Administration; Diplomat to the American Board of Psychiatry and Neurology.

Dr. Campbell presented an extremely interesting discourse on, "The Psychosomatic Aspects of Nutrition."

Dr. Campbell was thanked graciously by Konigsberg and Lussier and the meeting adjourned at 9:45 P.M.

ROY C. COWDEN,
Secretary-Treasurer.

Southern Section of the Pacific Coast Society of Orthodontists

The regular quarterly meeting was held at the Rodger Young Auditorium, 935 West Washington Blvd., Los Angeles, Calif., on Friday, Sept. 8, 1950. Since Harry Faulkner, Chairman, was unable to be present, Merle Davis took his place and also acted as the Chairman of the day.

The first part of the meeting was devoted to business. The Secretary read a letter from Dr. Arthur L. Everett, President of the American Society of Dentistry for Children, asking for a joint meeting with the Pacific Coast Society of Orthodontists, Southern Section. It was moved and carried that the Program Chairman arrange for such a meeting in the early part of 1951.

After some discussion about a change in our meeting place, Merle Davis appointed Robert Whitney, Harold Kratzer, and John Hopkins to serve as a committee to find a more suitable meeting place.

The afternoon was devoted to very interesting table clinics. Robert Gawley demonstrated the varsatility of the universal appliance. Jess Linn reviewed his method of handling mixed dentition cases. Dallas McCauley showed early treatment case studies employing standardized orthodiagraphic roentgenograms.

In the evening, Jess Linn read a paper and showed slides to elaborate upon the "Mixed Dentition Treatment." He demonstrated some of the results that can be obtained by treating young cases. He stated that by gaining endocrine glandular balance and by correcting faulty diet, a more healthy body tissue is obtained for orthodontic procedure. By removing such physical etiological factors as thumb-sucking, bad leaning habits, and poor sleeping postures, orthodontic changes may be made more permanent.

Important is the early stimulation obtained by placing the teeth in proper relationship so that in function the cusps have proper interdigitation. In many cases when using this method of treatment the secondary period of treatment is very short and easy to retain. In treating young cases, according to Jess, it is easier to establish a condition toward more normal growth within the hereditary limitations of the individual.

A discussion period followed Jess's splendid presentation. John McCoy in thanking him expressed the appreciation of those present.

Members of the Southern Section extend good wishes to Harry Faulkner and Vernon Fluhrer who have been ill.

Members present: John R. Abel, W. Mahlon Adams, R. D. Andrews, Bernice Barkelew, Carl Bruggeman, Harry Cimring, Sidney Cross, Merle B. Davis, L. Everett, Eugene Farber, Fairman Fahrney, L. L. Furstman, Robert J. Gawley, T. Eugene Gould, Albert C. Heimlich, John B. Hopkins, Paul R. Husted, E. M. Johnston, Roscoe L. Keedy, Jess A. Linn, W. C. McCarthy, D. C. McCauley, John R. McCoy, Forrest D. Moodie, Theodore S. Martin, Herbert V. Muchnic, Noble Powell, John S. Rathbone, Ben L. Reese, Harvey Spears, Robert L. Whitney, John B. Wilson.

Guests present: Burton L. Fletcher, Al Funk, Rubard S. Hambleton, Merton E. Hill, Jr., Harold E. Kratzer, Carl L. Vollmer, George Boone, Lloyd Cottingham, J. Clifford Willcox, Philip L. Klein.

JOHN HOPKINS,
Secretary.

Pacific Coast Society of Orthodontists, Twenty-Second General Meeting

President Dillon tells us that plans for the coming February meeting are well under way and that an outstanding program has been arranged for you.

Of course, you have all marked off your appointment books for the dates, February 19, 20, and 21, for the big "get together."

Obituaries Taken From the Bulletin of the Pacific Coast Society of Orthodontists

JAMES THOMPSON WALLS

Dr. James Thompson Walls died on August 7, 1950. He was born in Portland on January 21, 1897, graduating from North Pacific College of Oregon in 1918. He first joined the Oregon State Dental Association in 1921.

He practiced general dentistry a short time in Powers, Oregon. He studied orthodontics at the Dewey School of Orthodontia in New York City and has since practiced orthodontics in Portland in the Medical Dental Building and in Salem. He was a member of the Pacific Coast Society of Orthodontists, American Association of Orthodontists, and the American Board of Orthodontics. He was also a member of Xi Psi Phi fraternity.

Survivors are the widow, two sisters, a son and a daughter, and five grandchildren.

(Reprinted from the *Oregon State Dental Journal.*)

JACK MONROE LOUGHRIDGE

The tragic death of Jack Loughridge was a great shock to his many friends in the dental profession.

Jack was born in Sacramento forty-four years ago, attended school there, then entered the University of California, College of Dentistry, in 1924. He married during his freshman year, and son Jim, known to many of us, arrived soon after. Jack graduated with the class of 1928 and practiced two years before attending the University of California, College of Dentistry, for graduate work in orthodontics. He practiced in Sacramento and Reno.

He was a man with tremendous energy, worked hard and played in the same way. He attended meetings with a great deal of enthusiasm and had the ability to enthuse those about him. He was a liberal friend to a fault and was always ready to share another's trouble.

Jack was a good orthodontist, always striving for perfection. His patients loved him and the dental profession respected him.

Death has taken a fine man from us and we will miss him greatly, yet we cannot help but feel that in that mystery of the Great Beyond we will again hear that strong voice call out, "Hi-ya Buck!!"

May we extend our deepest sympathy to Mrs. Loughridge and James.

WILLIAM R. SMITH.

Program of the Chicago Association of Orthodontists for 1950 and 1951

OCTOBER 30—BISMARCK HOTEL—THIRD FLOOR

Changes in the Alveolar Bone During Physiologic and Orthodontic Movement of the Teeth. Dr. Harry Sicher.

Discussion. Dr. Milton B. Engel.

NOVEMBER 27 AND 28—HOTEL ROOSEVELT—CEDAR RAPIDS, IOWA

(Joint meeting of the Chicago Association of Orthodontists and the Central Section of the American Association of Orthodontists.)

Correction of Abnormalities of Occlusion by Grinding. Dr. Charles H. M. Williams, Toronto, Canada.

JANUARY 29—BISMARCK HOTEL—THIRD FLOOR

Some New Concepts in Treatment and Retention. Dr. Benjamin Weiss, Newark, N. J.

MARCH 26—BISMARCK HOTEL—THIRD FLOOR

New Horizons in Case Analysis—Clinical Cephalometrics. Dr. T. M. Graber.

Discussion. Dr. William B. Downs.

APRIL 30—BISMARCK HOTEL—THIRD FLOOR

Table Clinics of Finished Cases Five or More Years After Treatment. Dr. Allan Brodie, Dr. James Ford, Dr. Ernest Myer, and Dr. Richard Smith.

Dutch Society for the Study of Orthodontics

A postgraduate course sponsored by the Dutch Society for the Study of Orthodontics was held on July, 11, 12, 13, and 14, at Utrecht, Holland.

The course was given primarily upon the subject of the technique of the Johnson twin wire appliance. The course was attended by 32 students including 4 Frenchmen, 4 Belgians, 2 Englishmen, 2 Scotchmen, 2 Swedes, 1 Swiss, 1 Finn, and 16 Dutchmen.

Surgeon General Urges Prompt Application for Commission

In response to queries from physicians, dentists, and veterinarians subject to military service under present draft criteria, Major General Raymond W. Bliss, Army Surgeon General, announced today that every effort is being made to process applications for reserve commissions so that draft registrants will receive them prior to receipt of induction orders.

"Many who are now subject to military service since the passage of Public Law 779 of the 81st Congress have written to ask when they should apply for commissions," General Bliss said. "Our answer is to advise them to apply as soon as possible. Registrants who have been ordered by Selective Service to report for induction into the Armed Forces cannot receive commissions prior to induction. Thus, we are making an intensive effort to process all applications for commissions prior to that time. A priority has been placed on all phases of this processing in an attempt to insure that all those now subject to service receive their commission in advance of the date on which they would normally receive their induction orders. Obviously, with the large numbers involved, the earlier we receive applications, the easier it will be to achieve this goal."

General Bliss reminded physicians and dentists concerned that those holding reserve commissions are not subject to induction, but are subject to recall under allocations approved by the Director of Medical Services. They will receive an additional $100 monthly pay while on active duty. Those registrants who are inducted into military service, even though commissioned subsequently, are not eligible for this extra compensation.

Notes of Interest

Richard A. Lowy, D.D.S., announces the association of William Page Carter, D.D.S., with him in the practice of orthodontics at 302 Main St., Chatham, N. J.

Michael S. Zoradi, D.D.S., announces that he has assumed the orthodontic practice of the late Dr. J. M. Loughridge at 216 Medico-Dental Bldg., Sacramento, Calif.

OFFICERS OF ORTHODONTIC SOCIETIES

The AMERICAN JOURNAL OF ORTHODONTICS is the official publication of the American Association of Orthodontists and the following component societies. The editorial board of the AMERICAN JOURNAL OF ORTHODONTICS is composed of a representative of each one of the component societies of the American Association of Orthodontists.

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American Journal of Orthodontics

Official Publication of the American Association of Orthodontists,
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The American Board of Orthodontics

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